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THE CURIOUS HISTORY OF A BUTTERFLY.

BY SAMUEL H. SCUDDER.

Of all American butterflies *Brenthis Bellona* presents the strangest history. Everybody knows that butterflies pass through several stages of growth, from the egg, caterpillar and chrysalis to the butterfly — a cycle of changes which succeed each other with perfect uniformity from year to year; it is also known to most who read these pages that many butterflies pass through this cycle twice or even thrice in the course of the year, while others again are "single-brooded." If one should assert that *Brenthis Bellona* was single-brooded, most, if not all, observers would say it was an error; do not butterflies of this species, fresh from the chrysalis, appear late in May, again in July and still, once more, in September? — true, and yet, properly speaking, the insect *is* single-brooded.

In this genus — at least in *B. Bellona* and *B. Myrina* — occurs a phenomenon, which, so far as I know, is quite unique among butterflies; there are two sets of individuals, each following its own cycle of changes, apparently with as little to do with the other set as if it were a different species; each set has its own distinct seasons and thus gives rise to the apparition of two or three successive "broods" in the course of the year.

At the very end of the season this butterfly will be found laying eggs, which hatch in a few days; the little caterpillars, after

devouring their egg-shells, refuse further food and undoubtedly hibernate in this state — which is nearly equivalent to remaining in the egg; for eggs of Lepidoptera may be found in midwinter, in nearly all stages of development, according to the species. These juvenile larvæ represent the hiemal condition of one of the two sets of individuals above mentioned; this we will term the æstival series; for by the end of the following June, the caterpillars have attained their growth and, passing through the chrysalis state, emerge as butterflies about the middle of July; these are the butterflies of midsummer, continuing upon the wing until the end of September. In this butterfly, the eggs are wholly undeveloped at the birth of the female, and in the æstival series are not deposited until September; they hatch in from five to nine days and the young caterpillars, as we have said, pass directly into a state of hibernation, making the cycle of the year's changes complete with a single generation. This history is quite similar to that of the New England species of Argynnis, all of which are single-brooded, appear in early summer, lay their eggs in early autumn and hibernate as juvenile larvæ; but these have not superadded the second series of individuals which form so striking a feature in the natural history of some of our native species of Brenthis.

This second set of individuals, which we will term the vernal, in contrast to the æstival series, hibernates as *half-grown* caterpillars and produces the earliest brood of butterflies; these make their appearance about the middle of May, although they are occasionally seen earlier; they are hardly common before the end of the month and are as long-lived as their companions of the æstival series; they do not lay their eggs until the latter part of July and early in August — just when the butterflies of the æstival series are becoming common; the eggs hatch and the caterpillars grow as usual for a few weeks, sloughing their integuments twice; beyond this point all the caterpillars do not develop alike; some continue in what would appear the natural way; we will first follow them — it will be to their grave! As caterpillars they eat, as chrysalides they sleep and then appear in September, gay and frolicsome butterflies — doomed to an untimely end. Their sisters of the æstival series are busily laying eggs to perpetuate the race,*

*For the phenomenon of midsummer is now repeated inversely, one series ovipositing, the other emerging from the chrysalis.

but to them is this boon denied; the cold autumnal blasts sweep them away before the eggs are half developed in their ovaries. It is, in fact, a vain effort of Nature to develop a second brood which, in a more southern climate, with a longer season, would prove successful.

But we have said that this was the history of some only; and this fact proves the salvation of the vernal series; when about half grown, in the middle of August, while the weather is still hot, a portion of the caterpillars suddenly cease to eat and fall into a state of lethargy. Something similar to this, if we may trust the observations of Vandouer, as related by Doubleday, has been noticed in a European species of this genus, but earlier in the season, when it would seem to be more unaccountable, because, so far as we can see, less necessary. "Having succeeded," says W. Doubleday, "in obtaining some eggs of this species (*B. Euphrosyne*), which were laid about the middle of May, I fed the young larvæ produced from them until the end of June, when they all fell into a state of complete torpidity, in which most of them remained until the following spring. But in August a portion of them woke from their sleep, fed with voracity, changed their skins twice, became pupæ and in a few days perfect insects. It was only at the end of the following February that the others commenced feeding, changed their skins twice and after the first week in April became pupæ, from which the perfect insects appeared at the usual time." By this account, the butterflies lay their eggs on their first appearance; either they differ *in toto* from their congeners in America or there is some error in this statement. The state of lethargy into which our August caterpillars sometimes fall may perhaps be better denominated premature hibernation, for they do not arouse themselves until the following spring, when they again resume the cycle of changes peculiar to the vernal series, and by this extraordinary habit preserve its history.

Here we have two independent series in the same species, each single-brooded, but one making an effort toward a second generation, invariably ending in disaster; the butterfly may therefore be properly considered as "single-brooded," although differing greatly from other single-brooded butterflies, by presenting three distinct apparitions of the perfect form. Whether, by any lethargic freaks, the caterpillars of the two series even unite their faces and finally have a synchronous and parallel development, we are

as yet unprepared to say; but that the blood of both series ever commingles, through the union of the perfect insect, is very improbable because, although the generations overlap, the males of a brood are the first to disappear and the females the last to appear, and at best there would be few that could thus mate; moreover, since the eggs of the freshly enclosed females are not fully developed for weeks, or even months, the effect of such a union would be questionable. Yet, if there is no union between the two series, there are the vernal and æstival groups practically as distinct from each other as any two species! Nature strives toward the formation of a double brood in the vernal series; may we not suggest that she has already made considerable progress toward the development of a new species, in producing the vernal series at all? Pass in review the histories of different species of the same genus or even allied genera of butterflies, and you will find in them a remarkable similarity — trace of a law of unity in habits and seasons as pronounced as that of unity in coloration and structure, extending not only to the number of broods, but also to their seasons. In the æstival series of Brenthis we find indeed something very similar to what occurs in Argynnis, and this must therefore be considered the normal series; but, in addition, we have a second set of individuals maintaining a totally distinct season, by other means (lethargy or premature hibernation), passing the winter in a different condition, and even attempting an additional generation — showing a difference such as usually characterizes somewhat distant genera. Will not Messrs. Cope and Hyatt claim this as a new argument in favor of their theories of the origin of species?

Whether any colorational or structural features distinguish the butterflies of the vernal from those of the æstival series, I am unable to say and must leave to those who can follow the insect in the field; it is a question worthy of investigation, since the spring and autumn broods of butterflies often present differences so well marked that the broods have been described as distinct species.

Some one will ask whether these different apparitions of the butterfly cannot be accounted for on the supposition of a *single* series of individuals, with lethargy on the part of the caterpillar, as in the case of the European Euphrosyne. Plainly not; for we have in our butterfly three apparitions instead of two, and two

depositions of eggs in place of one; moreover, the fact is sufficiently established, that some of the caterpillars of the vernal series hibernate when half grown, after a period of lethargy and that the æstival series can only pass the winter as caterpillars just from the egg; so too is the period of oviposition; these facts being granted, and the apparition of the butterflies known to all observers as occurring at the times stated, any other interpretation seems impossible.

In all plural-brooded butterflies, with an extensive distribution in latitude, the number of generations varies with the length of the season. I am not aware that the mode of this variation has ever been studied; are the changes sudden or gradual? and do they involve any waste of energy on the part of Nature, as in *Brenthis Bellona?* A little consideration will show what the result would be in the species under discussion; should the season be so long that the second brood of the vernal series could lay eggs, these eggs would at once hatch, for their normal period being often as short as five days, weather which could induce a butterfly to lay eggs would at once ripen the embryo; the caterpillars would then be forced to hibernate as those of the æstival series and become members of that series the next year; while the vernal series would be kept up by means of those caterpillars of its first brood which, in the previous year, had gone into premature hibernation. Thus the vernal series would continually feed the æstival; yet it would suffer no greater loss than it does at present in the practical sterility of the September butterflies; it would be subjected to no infusion of blood from the æstival series and any variation of structure from the normal type of the species, induced by its isolation, would not be lost. Were the season still longer, the vernal series would become double-brooded and independent, the caterpillars having time to attain half their size before hibernation; the lethargic propensity would be retained only by the æstival series, which, by this time, would probably have assumed the position our vernal series occupied at the beginning.

If, on the other hand, we suppose a shorter season, such as actually exists in some parts of the country where *Brenthis Bellona* occurs, undoubtedly the first change would be the entire elimination of the September butterflies and the hibernation of all the vernal caterpillars when half grown; this is probably the actual state of things in the cooler parts of Canada; but what would be

the further backward steps toward the simple condition of Argynnis —that is, toward the extinction of the vernal series—it would be hard to conjecture, without treading on insecure ground; rather let us leave that to the future development of parallel facts. —*Menton, France, April*, 1872.

ON THE GEOLOGY OF THE ISLAND OF AQUIDNECK AND THE NEIGHBORING PARTS OF THE SHORES OF NARRAGANSET BAY.*

BY PROF. N. S. SHALER.

General Topography.— The contour of the shore at this point of our coast at once indicates some peculiar features in the history of the rock masses in which it lies. A great indentation of the coast line having a width of twelve and a depth of over twenty miles, cut here and there with narrow islands and running up into the land in long river-like arms for many miles beyond the limits of its main area, Narraganset Bay, leads us to seek for some forces operating in its formation which were not at work, at least with the same energy, in the region of shore more to the southward and westward. A glance at the general topography will show us more clearly what is to be regarded as peculiar and requiring an explanation from the ancient history of this region.

Nearly the whole of the excavation of Narraganset Bay lies in a region commonly known as Carboniferous.† The great excavations of the Chesapeake and Delaware lie altogether in a region of soft, easily disintegrated material and are thus not comparable with what we have here. The valleys of the Connecticut, the Hudson and the Thames, nearer to the region we are studying, are in the same sort of rocks, or those of nearer equivalent hardness, and are therefore more likely to give us a measure for the forces acting here. But we find that these latter

* This and the papers to be hereafter published in the same series, are extracts from a Report to Prof. Benj. Pierce, Superintendent of the United States Coast Survey, and are made public by his permission.

† It will hereafter be shown that a very large part of this region generally mapped as carboniferous is in all probability of a very much earlier age. The evidence goes to show that it is a member of the Cambrian series.

indentations have the simple structure of river excavations presenting, it is true, the character of valleys which have been subjected to other eroding forces than those which have come from flowing water, but still being single and rather narrow indentations in the axis of considerable streams. As we go to the north and east beyond Narragansett Bay, we find indentations of the same general character; at first, obscurely on the southern shore of Massachusetts, but in great abundance and of a perfectly comparable shape on the coast of Maine and the whole shore of the continent to the northward. Thus we see that this Bay is, in fact, the southernmost point of the fiord structure on our coast and is on this account a favorable point for the examination of the causes of the formation of that type of coast line. If we take a number of sections across the whole of the Bay at several points, say at the mouth, five miles from the southernmost point of land, again parallel thereto through the centre of the town of Newport, and further on in succession in an east and west direction through the upper part of Newport island and the island of Prudence; through Bristol and lastly through Fall River, we shall see by these diagrams that the bay gives us a number of furrows and ridges having each a width of from half a mile to five miles and a height or depth from the bottom level of from one hundred to four hundred and fifty feet.* If, however, we take a section in a general north and south direction through any of these channels of Narragansett Bay, we shall find that it presents us with essentially an inclined plane sloping pretty gradually from the northern or inner end toward the sea on the south. The indentations of these channels into their shores are comparatively few and of no great depth. At some points the original islands have been soldered together by marine drift materials so as to destroy the original simplicity of arrangement, but usually throughout the Bay the contours show us a predominance of north and south reliefs. As will be seen by examining the contour lines of the coast survey map, on the scale of $\frac{1}{19,000}$, the nearer ridges of the principal island conform in course in a general way to the trend of the shores of the main islands; showing thereby that it is to some very general action that we owe the existence of these north and south trends.

*Three of these transverse sections are given in the diagram Pl. 6. It will be seen that each great channel is a broad but relatively shallow excavation. The drawings from which the sections were made were carefully prepared from the records at the Coast Survey Office in Washington.

It will be noticed that the island has no streams of considerable size; none, in fact, which could have been competent to create the wide and deep depressions we find in the larger valleys of the island by direct abrasion. In some of the minor valleys near the shores, as at the glen on the east side of the island, we have real stream valleys with the normal V-like excavations, but in the larger depressions occupied by the streams the form is very much more rounded and the size usually many times as great, giving broad U-shaped troughs, in which the streams, though in fully close contact with the bed rock, have very little effect upon it. They are manifestly incapable of creating the valleys in which they flow. To account for these depressions we are forced to suppose either of several things; we may suppose that the valleys are the relics of the topography which may have existed here before the Bay was formed, and that the streams which made them gathered their volume in the land which then occupied the space where the waters now lie and a part of the region beyond; we may seek an explanation of their formation in the action of the sea during a former period of partial submergence, a probable source of valley-making, according to the view of many geologists, or we may perchance find that to the erosion of the ancient glacial streams we owe the development of what the brooks only began.

The first supposition is manifestly inapplicable to a number of the valleys of the island, and these among the most important; that which owing to the want of any well established name has been termed the north valley, being that occupied by the stream which debouches just south of the Aquidneck coal mines, does not extend across the island but has its head within fifty feet of its highest hill. On the part of the island to the south of this valley we have several considerable depressions of the same character. Only one of these, that which lies immediately to the north of Newport, is continued clear across the island, but even here the central part of the valley lies so high as to afford hardly a reasonable impression of its having been the valley of an ancient river. A careful consideration of the question has led me to conclude that this hypothesis is inapplicable to any of the valleys of the island. The question of the marine origin of these depressions is easily dismissed. If competent to produce these valleys we should find the sea still at work extending their contours at the point of contact of sea and land. It is sufficiently evident that no such action is now going on. The sea is now making slight inroads upon

the land along nearly the whole shore of the island, but the slight waste is not taking place in any greater measure at the mouths of these valleys than at other points. I am inclined to think it eminently probable that these valleys are the result of the amplification of the original stream excavations, by the action of the moving sheet of ice which we shall see there is abundant reason to believe to have rested on this region during the drift period. Long before the present topography was established, probably at a time so remote that the present surface was buried more than one thousand feet beneath accumulations, which have since been worn away, the island had already been separated from the main land. The ice period found certain valleys already cut in the rock, their general course coinciding pretty closely with the direction of the flow of the ice, as will be seen by examining the indicated direction of the ice as determined by the glacial scratches. It is eminently probable that the glacial sheet was pretty nearly level on its upper surface, not having that surface conforming to the hills and valleys which lay beneath. It is evident that where the stream lay deepest the wearing would have been the greatest, for the rate of motion being the same, the wearing of a glacial stream is in proportion to the weight it brings upon equal areas. Thus the valleys would have been deepened and widened until out of proportion to the magnitude of the streams of water which course through them since the glacial sheet went away.

The importance of this consideration has been overlooked; it needs to be considered if we would form clear ideas of the cause of the irregularity in the excavations of all glaciated regions. Sometimes this great difference in the erosive action may be in part attributed to the difference in hardness of the rock acted on. But that this is not the principal cause is shown by the great irregularity of glaciated surfaces and underlaid by the most uniform syenites. In ordinary ærial erosion the beds of the streams are generally kept away from the rock by a padding of debris; but in glacial action these protective agents in running streams become the very sharpening of the ice tool and do the work of erosion instead of protection. By reference to the diagrams (Plates 6 and 7), it will be seen that the channels between the islands have an average depth of about one hundred feet below the water line. They gain their depth quite suddenly and then preserve their gentle slopes across their whole breadth. Their variations in

depth may sometimes be connected with a variation in the hardness of the material in which the excavation is made.*

Since the formation of these depressions a considerable amount of filling has been going on which has doubtless done much to modify the form of the bottom and diminish its depth. There are no data for estimating the amount of the accumulation; it has probably not exceeded an average of one hundred feet. Although not expressly made for that purpose, the diagrams also show that the land surfaces are considerably more irregular than those caused by water; water action when the land is buried beneath it tends to make the surfaces uniform while it works to the opposite effect when it acts upon the land lands. There are reasons to believe that the channels to the east and west of the island were occupied by distinct glacial streams for a short period towards the close of the last ice time. The duration of these local glaciers must have been short, inasmuch as the distinct termina lor lateral moraines are few and indistinct.

Excepting the extreme ends of the island the topography is of the simplest character; the broad valleys have slopes of remarkable similarity showing that the material in which they are excavated must have a tolerably uniform consistency. The extreme southwest and northeast ends of the island have contours which contrast remarkably with the middle region. The region known as the neck, lying just south of Newport and the harbor thereof, is one of the most irregular surfaces in New England. At first sight it seems a mere confusion of ice-worn rocks and transported masses piled without order. A little examination shows, however, that here too we have a set of valleys which have a prevailing north and south course, the sides and bottoms of which have been worn into the irregular shapes, which give the chaotic look to the surface, by the action of the flowing water and the old ice mass. The rock being of very varied hardness has worn with different rapidity at different points and so has come to have a very rugged surface. The lines of fault indicated in the diagrams† bring up into contact with this irregular surface the beds of the coal formation, materials as homogeneous as the others are variable. The homogeneity in the character of the latter rocks has caused them

*The great valleys which now form the Bay were doubtless originally the insignificant troughs of small streams which have been developed under the conditions above indicated.

†These diagrams will be given in the next number of this Journal.

to wear uniformly and so to give a very even surface to the country they underlie. This uniformity characterizes all the region between the Lilly Pond and Almy's Pond on the south and the bay known as Blue Bill Cove on the north, with the exception of the strip lying east and west between the Paradise and Purgatory rocks on the east and Miantonomi Hill on the west, wherein there are several exposures of conglomerates and slates which, wearing unequally, have given a broken and irregular character to the surface.

At the extreme northern end of the island, between Blue Bill Cove and the portion of Narraganset Bay known as Mount Hope Bay, there is a small area of the same character as that to the south of Newport, brought up by a fault into contact with coal-bearing rocks. Here also the irregular hardness of the rock has caused it to wear very irregularly.

The continuous sheet of superficial accumulations hereafter to be described does not have any considerable effect in altering the contour of the surfaces except in the finer details of particular points. On the west shore of Blue Bill Cove there is a surface of about one hundred acres which shows a type of topography which occurs at a number of points on our New England shore and is very difficult to understand. The general surface is very nearly a true plane and is underlaid to the depth of more than thirty feet, or below low tide mark by unstratified drift composed principally of materials less than one foot in diameter. The surface of this plain is broken at a great number of points by depressions which recall the character of the sink holes of many limestone countries, though no such explanation will possibly apply to their formation. These depressions vary much in size some of them being several hundred feet in diameter, though usually they do not exceed one hundred feet across, and twenty feet in depth. Generally their outlines are rudely circular, though in some cases they exhibit considerable irregularity of form. At some points these cavities are so crowded together that they encroach upon each other and the plain becomes converted into a warped surface of a singular degree of complication. A precisely similar surface occurs on the low terrace to the south of the town of Quincy, Mass. The conditions both of material and environment are the same in both cases.

There are a few possible means of accounting for this arrange-

ment which suggest themselves; none of them, however, seem quite to satisfy the facts. The most natural conjecture seems to be that the irregularity was made at the time of deposition of the material. Had it taken this shape afterwards the only possible supposition would be that marine currents had produced the excavation during a period of depression. This, however, is distinctly negatived by the fact that the coarse as well as the fine material has disappeared, there being no such mass of boulders on the bottom of the depression as would exist on this supposition; moreover, it is really impossible to account for the existence of such great eddies in the positions where these great excavations occur, at points remote from large obstacles such as could set great tidal currents whirling. Limiting ourselves to the conditions which could cause irregularities in the deposition of the drift, we still find the matter beset with difficulties. In the first place, it is difficult to see what could have caused such lacunæ in the distribution of drift matter, within or on the surface of a glacial sheet. The most satisfactory explanation seems to be that the greater part of the drift which lies here was borne on the surface of the glacier and that these openings in the moraine matter answer to gaps in the ice on the surface of the glacier, caused perhaps by the action of streams such as are often seen to originate on the surface of a glacier and then to find their way in straight shafts to its base. Such cavities would remain even after they became closed or disused, being covered with drift or quite bare, and at the time of melting their place would be marked by just such cavities as these.

Other depressions exist on a larger scale at the points occupied by the several ponds of the island; none of these ponds seem to be complete rock basins all having, or having had, deep channels connecting them with the sea. Blue Bill Cove seems to be entirely formed by the drift masses which surround it, except when the syenite rock makes a part of its northeast border. Easton's Pond, near Newport, is the next depression to the southward. We have one of the valleys of the island cut down by the glacial stream until its mouth lay beneath the level of the sea; when the ice disappeared the valley constituted a fiord-like bay. The action of the sea seems to have made two successive beaches across the valley, one about one-half the distance from the present shore to the head of the pond, the other forming the present bathing

beach of Newport. South of this point we have two considerable ponds, Almy's and Lilly pond; both of these and the marshy pond just to the west of the latter are glacial excavations. The last is closing by the accumulation of vegetable matter, its waters having become shallow enough to bear an abundant vegetation, which is rapidly converting it into a peat bog. The island is singularly free from perfectly level lowlands, such as are formed by the filling up of old ponds, and the few sheets of water which remain are not disappearing with the rapidity usual in New England.

The process of occlusion in these ponds can be studied to advantage in the marshes between the Lilly pond and Bateman's. The vegetation, consisting of a variety of marsh plants, begins its growth at the shore where there is a sand beach and bold water, but it may be a long time before its foothold can be made good. Some accident such as a landslide or a fallen tree makes a little shelter, so that the plants get a hold in the water. In a short time they make a bed a foot or more in thickness; their roots go so deep that soon they can stand a considerable beat of the wave. The commotions in the water tear away and distribute over the floor of the pond a part of the mass, but it continues to grow and gains on the clear space, often at the rate of several inches a year. Where the circumstances are favorable, we find the mat of plants extending from the shore over the pond, without touching its floor, sometimes for only a few feet, again, at times, covering many acres with its growth. The accumulation of sediment under these conditions takes place in a singular fashion; the mat of vegetation floats upon the surface of the pond, and sinks deeper and deeper as it grows until, finally, it rests upon the bottom. It then continues to grow until it has gotten itself so far above the water, that the vegetation no longer has the necessary amount of water.*

The topography of the island, as a whole, is remarkable for the small extent to which it expresses the structure of the rock below.

* This process of growth makes the peat bogs of all countries the natural repositories of the implements of man: where a stone tool remained on the surface it was likely to be found again and again, and used until its very chips were worn away. Falling into a bog, slipping through some crevice in its top crust, it sank to a secure hiding place. The fact that implements can penetrate so deeply into bogs makes them very untrustworthy recorders of time. An implement of the stone age may get buried in the solid matter two feet from the surface, while a modern piece of work falling into a more open spot may sink far below it. When the bog comes to be excavated the deeper buried object is naturally, but mistakenly, taken for the older.

When we come to study the disposition of the underlying rock we shall be struck by the great amount of perturbation the beds have suffered; they are thrown into real mountain irregularities. Few parts of the Alleghanies are more seriously disturbed, but the surface preserves no semblance of mountain forms. It does not differ from the shape which horizontally lying rock would give. If the character of the surface had been given by water action, then we should have had something very different from this. The valleys would then have mapped for us the attitude of the strata and the elevations would have been much greater and differently disposed from what they are now. But under the sheet of ice these details of structure lose their value; the ice cannot turn and twist as the water does, only a slight deflection even under the most important resistance can be permitted. The result necessarily is that the glacial stream wears away without much reference to the disposition of the beds beneath the surface. This is a point of more than local importance; it may serve often as a general guide to the determination of the question whether any particular country shows the result of glaciation. When the topography of any region does not express the structure of its underlying materials, in the fashion common to all surfaces of purely aqueous erosion, then there is reason to suspect the action of ice. This suspicion may amount to a certainty wherein the whole topography has been created with the great independence of internal conditions which it here exhibits.

There is a general absence of sand and pebbles in the beaches about this island; this is, probably, primarily due to the fact that drift has not been enough washed over by the sea to remove the arenaceous matter. The sand mass of Nantasket or Lynn beaches alone much exceeds all that exists in the spits and beaches about Narraganset Bay. The small extent to which the drift has been robbed of its sands is due to the original slight submergence of this district; only about ten to twenty feet of emergence is indicated, so the region has not been so much washed over as the region more to the north. There are great bodies of sand on the shores to the north and south; its comparative absence here is to be explained by the want of recent great movements of the land, and the deep water which prevents its movement along the shore from the east or west. As we go south of this region we come into the area of positive subsidence since the glacial period. This

change of land is quite as favorable to the collection of sand along the shore line as the process of elevation. In general the existence of great quantities of sand along an ocean shore may be taken as probable evidence of recent geological movements which have enabled the sea to work over a great amount of débris, of which it has left the heavier part where it found it, and has heaped up the lighter parts where its currents naturally swept them. It will hereafter be shown that the whole region of Narraganset Bay has less drift than exists in the regions further to the northward; it also has few stretches of shore which furnish quantities of sand to eroding agents and none of those great rolling beaches, such as abound to the northward where thousands of tons of pebbles, rushing to and fro under the beat of the waves, are gradually ground into sand and mud. The rocks exposed about Narraganset Bay to the full surge of the ocean are mostly stubborn resisters of the waves, and where masses break away they generally fall into deep water where they are not ground up by the waves. There are no currents working along the shore, which are capable of transporting sands from either the Cape Cod shore or the great masses of Long Island. We see that circumstances have coöperated to keep the inlets of this diversified and beautiful region of our shore free from the overwhelming sands, which in the regions a little to the east or west would have soon closed or effaced them. Nothing can be more strikingly contrasted than the topographical results of water in its solid and its fluid states. Where it moves from the land in the solid phalanx of the glacier it rends a coast into shreds, as ragged as a cloud blown out by the wind. In the sea with the ever varying action of waves and currents, it works to restore the uniformity it destroyed before. Its waves dig down the heights and fill up the hollows, its currents build moles across the inlets and give them over to the agents which speedily convert them to marshy plains.

At the close of each of the many great ice periods in the earth's history the fretted line of the fiord zone was probably swept clear of its débris of all kinds. Then began the process of occlusion which continued until the ice came again to renew its work.

In recognizing the harbors and inlets of Narraganset Bay as glacial work, we get an example of the agent which has given nine-tenths of the havens of our seaboards. That the people of the northern part of Europe have been universally maritime is

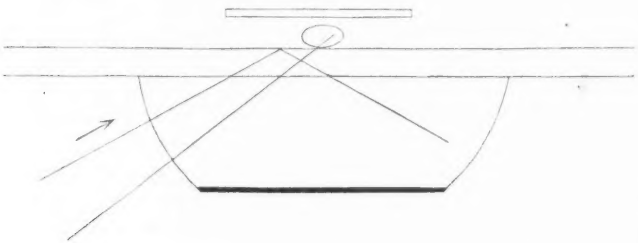
due, in no small degree, to the recurrent ice action of the northern hemisphere, so close is the connection between this most destructive agent and the highest life.

THE NEW IMMERSION ILLUMINATION.

BY R. H. WARD, M.D.

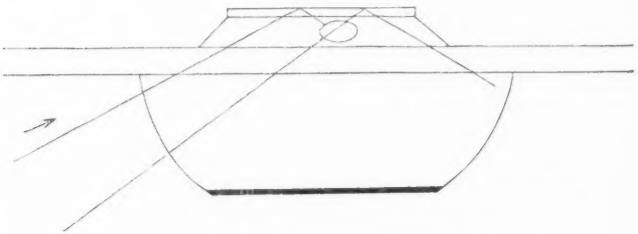
THE new illuminating lens, introduced by Mr. Wenham recently, has proved to be a sufficiently important accessory to the microscope to command more attention than it has yet received in this

Fig. 123.



country. A small plano-convex lens, nearly hemispherical, has the central part of its curvature stopped off with black varnish; and for convenience the part intended to be thus suppressed

Fig. 124.

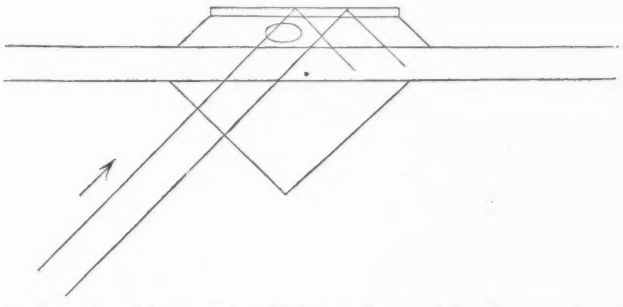


may be ground away as shown in Figs. 123 and 124, the ground surface being subsequently painted black. The lens thus prepared is temporarily attached by some highly refracting medium, such as

glycerine or oil of cloves, to the under surface of the slide. It becomes, manifestly, an immersion spotted lens; though it has lost so much of its angular aperture, to say nothing of the difficulty of placing the object in its focus, that it can no longer be used as such. Its available action is that of enabling us to throw light obliquely into the slide at such an angle, ordinarily impracticable, that it shall suffer total internal reflection from the top of the slide (Fig. 123), or from the top of the glass cover when that is optically identified with the slide, as when we examine an object in balsam, glycerine, etc. (Fig. 124).

For many years our best means of producing this effect was a prism, as shown in Fig. 125. A small prism is attached to the under surface of the slide, temporarily, by soft balsam or by oil or glycerine in the case of mounted specimens, or permanently,

Fig. 125.



by balsam to a blank slide which is to be used for the occasional examination of unmounted specimens. This arrangement gives so little light, and so little control of the angles at which the light meets the axis of the object and the axis of the instrument, that it has been but little used and with indifferent results.

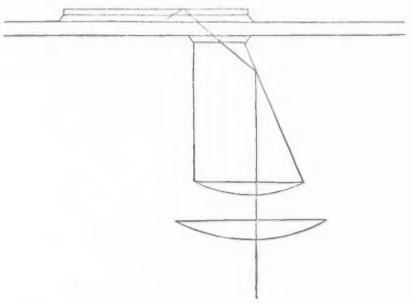
Mr. Wenham's lens removes all these difficulties. It is easy to get light enough for moderately high powers; and the light can be thrown upon the object at a considerable range of angles and from any side or from all sides at once. When light is to be supplied from one side only, it may be directed by a rectangular prism or a Reade's prism, or an (inclined) achromatic condenser of long focus and small angle—such as a two-inch or three-inch objective; while from all directions at once it is best supplied by the common glass paraboloid. The latter effect may be obtained, as explained

by Prof. Biscoe, by the common paraboloid alone, it being converted into an immersion instrument by filling its cup with water.

These means of illumination, now for the first time available, may act in three distinct ways, one of which is new.

The new method is applicable only to objects mounted dry, and is illustrated by Fig. 123. It has been called, by Rev. S. Leslie Brakey, Internal Illumination. All the light suffers total internal reflection from the upper surface of the slide except that which meets the surface at the points of contact of the object, and the rays thus excepted enter and illuminate the object. Of course the object must lie upon the slide, and beginners are often puzzled by

Fig. 126.



failure, not suspecting or remembering that the object may have been mounted upon the under surface of the cover.

The two other methods are the common opaque illumination and dark-field illumination, which are illustrated together in Fig. 124, as they are usually employed together in practice. They are applicable only to objects mounted in some medium, in which case the top of the cover becomes, optically, the first surface reached by the light after entering the lens. The upper ray in Fig. 124 represents this method of opaque illumination, the ray being reflected by the cover upon the object. The lower ray represents the dark-field effect, the object being illuminated precisely as by the common paraboloid, only the field is darkened not by the obliquity of the rays passing through the cover but by the fact that they are reflected back by it.* Hence its greater complete-

* This illumination is not exactly represented in the diagram. Most of the light reflected down by the cover is that which passes by the side of the object, and not that which passes through the object. This is shown in Fig. 125, but simplified in Fig. 124.

ness and its applicability to large angular apertures. Its effect is superb with powers as high as $\frac{1}{8}$ of 130° or 140°, especially when used with the binocular.

In practice it is not easy, nor often necessary, to separate the latter two methods. They separate themselves according to the character of the object. With an absolutely opaque object the opaque illumination will alone be accomplished, the dark-field effect (lower ray of Fig. 124) being necessarily suppressed; and success will probably be difficult and only indifferently good. With sufficiently translucent objects the opaque effect would be insignificant, but the dark-field effect easy and excellent. Objects just opaque enough to answer equally to both methods give a confused result, which might possibly be valuable in exceptional cases.

The latest contrivance (Mr. Wenham's, of course) for an immersion illuminator is a glass cylinder half an inch long, one side of which is ground off at an angle of 64° and polished to furnish an internally reflecting surface. The upper end approaches the bottom of the object slide, the interval being filled with water as in the use of an immersion lens, and the lower end is ground to a convex surface whose refracting effect on the pencil of light is supplemented by a plano-convex lens placed below it. In fact we have something like a Wollaston's doublet for a condenser, whose cone of light is twice bent by internal reflection so that its apex is in the position of the object between the cover and the slide. In the diagram (Fig. 126) only a central ray is represented; but in use nearly all the light falling upon the lower lens is brought to a focus on the object, giving an abundance of light and remarkable results with high powers. The apparatus is so mounted on the sub-stage as to rotate around its own focal point as a centre; and excels the former appliances in giving a more intense one-sided illumination, in confining the light to the object instead of lighting up everything in the neighborhood, and in allowing the slide to be moved or changed with facility.

Immersion achromatic condensers for transparent (bright-field) illumination have not yet received sufficiently extensive trial to ascertain their exact degree of usefulness; but they seem likely to come into use as a means of increasing the available angular aperture of immersion objectives, if not for other purposes.

ON THE CAUSE OF DETERIORATION IN SOME OF OUR NATIVE GRAPE-VINES, AND ONE OF THE PROBABLE REASONS WHY EUROPEAN VINES HAVE SO GENERALLY FAILED WITH US.

BY C. V. RILEY.*

THE GRAPE-LEAF GALL-LOUSE (*Phylloxera vitifoliæ*† Fitch.).—The experience of the past year, enables me to add much of interest and importance to last year's account of the above insect. This experience has already been made public in an article published in the "Rural New Yorker," and reproduced in the "Rural World" of St. Louis. I am pleased to know that the views there set forth receive the indorsement of such an experienced and practical man as Mr. Geo. Husmann, the well known grape authority in our State, and editor of the vineyard department of the last named journal.

It is well known that nearly all the varieties of the European grape-vine (*Vitis vinifera*) have, in the end, proved valueless when introduced and cultivated in the eastern half of the United States. The majority of them grow well at first, and a few exceptional cases might be mentioned where some of them, such as the Black Hamburg and Chasselas, have even fruited successfully for many years, especially when isolated or trained against walls; while

* We copy this from Mr. Riley's 4th Report as Entomologist to the State of Missouri, 1872, and have to thank Mr. Riley for the use of the cuts.—EDS.

† This is the specific name by which I last year gave an account of this grape-vine insect; and I employ it again for that very reason, and for the further reason that it is the name most familiar to the American reader. I have already given my opinion (3rd Rep. p. 95, note) that though the name is objectionable, it ought perhaps to be retained. It is doubtful, however, whether many other entomologists will agree with me; and while I believe in carrying out the "law of priority" to its fullest extent, consistent with reason, there are many cases where it must give way to that of "accord." The present is, perhaps, just such a case; for aside from the technical objection, Dr. Fitch knew so little of the insect's true characters, when he named it, that he cannot be said to have described it, and did not refer it to its proper genus which was already erected to receive it. His name will, therefore, doubtless give way to that of *Phylloxera vastatrix*, which Planchon first gave to the root-inhabiting form, and which has generally been recognized abroad. The same may be said of Westwood's name *Peritymbia vitisana*, which was also proposed for the same insect in 1868, in a communication to the Ashmolean Society of Oxford, England.

they more generally do well when isolated in cold houses. But the general truth of the first statement holds good. It is also well known that some of our native vines, which for a while were universal favorites on account of their productiveness, vigor and other excellent qualities, have of late years sadly deteriorated. Among such the Catawba was for a long time the popular grape; but its cultivation is now entirely abandoned in many parts of the Mississippi Valley, and even at Hammondsport and other parts of New York, and Nauvoo, Illinois, where it is still largely cultivated, I learn from experienced grape-growers that it is fast on the decline.

This deterioration — this failure, has been attributed to a variety of causes, for in the absence of anything definite and ascertainable to keep it within bounds, the speculative turn of our minds is sure to have full scope, and grasping at every shadow of probability, leaves no possible theory unsearched. As in all such cases, also, the mind gets lost in, and is satisfied to vaguely rest with, the theory least provable; and to some occult and mysterious change of climate we are at last satisfied to attribute the change though, if the meteorological records were carefully examined, they would probably show no difference in the mean annual condition of our climate during the past half century.

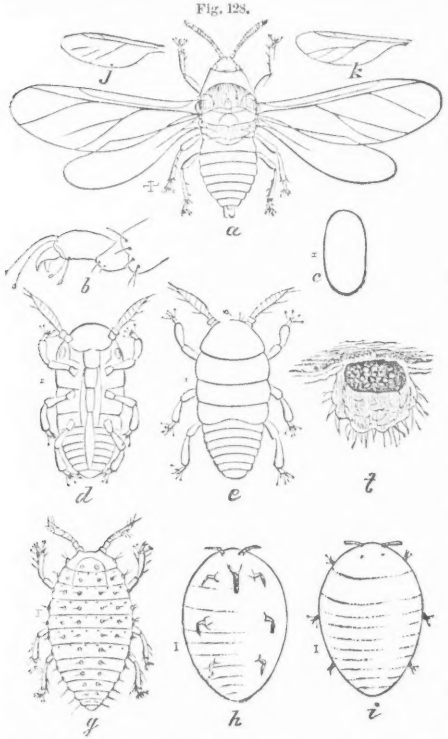
Fig. 127.

Leaf covered with galls.

It is very natural to suppose that vines of European origin should be less hardy in this country than our native varieties. that as in the case of the Spanish Chestnut, the English Gooseberry, etc., etc., there is something in our climate which precludes their flourishing as well here as there. I would by no means deny that such is the case, for it is this very comparative tenderness which predisposes them the more to the destructive agent of which I am about to speak. Yet when we consider that in some

parts of Europe, where the Vine flourishes, the extremes of heat and cold are as great as here; that we possess a great variety o soil and climate, and that by covering and other modes of protection in winter, we may, where necessary, counteract the rigor of the latter — it would appear that we certainly have attributed too much to climatic influence: and such a view is strengthened by the fact that our native varieties, if free from the insect which forms the subject of this article, usually do well when cultivated in Europe, and further that the *Vitis vinifera* is not a native of Europe, but of western Asia.

Fig. 128.



Grape Gall-louse: *a*, winged female; *b*, her tarsus, *c*, egg, *d*, the newly hatched gall-inhabiting type, ventral view; *e*, dorsal view; *f*, section of a gall; *g*, the tubercled root-inhabiting form; *h*, the mother gall louse at the height of her fertility, ventral view; *i*, dorsal view; *j* and *k*, differently veined wings of the Oak *Phylloxera* from Europe. All these figures are greatly enlarged, the natural size being shown by the hair lines at the side of each.

The above reflections are of a general character, but apply more particularly to the great State of Missouri, which is admitted to be, in many parts, eminently adapted, both by soil and climate, to the cultivation of the Vine.

One of the reasons why the European vines do well in California, outside of and beyond the more favorable clime in that portion of the continent is, no doubt, because the insect which here affects them, like many other species common on this side of the Rocky

Mountains, has not yet crossed to the other side. If such is the case, our California neighbors should take warning from Europe, and guard, if possible, against an invasion.

The announcement that I have at last ascertained one of the principal causes, if not the sole cause, of this decline, and that, knowing the cause, we may in a measure obviate it, will doubtless cause many a grape-grower to wonder. Some may even pooh-pooh the idea, and deem it impossible that they have so long remained in ignorance of so important a fact, that a "bug-hunter" should discover it at last. Let the facts speak.*

This destructive agent is none other than the little insect we are now treating of.

The general history of the louse, and the habits of the gall-inhabiting type were sketched in my last Report, and need not be repeated.

FURTHER PROOF OF THE IDENTITY OF THE AMERICAN INSECT WITH THE EUROPEAN.—That the two are identical there can no longer be any shadow of a doubt. I have critically examined the living lice in the fields of France, and brought with me, from that country, both winged male and female specimens, preserved in acetic acid. I find that the insect has exactly the same habits here as there, and that winged specimens which I bred last fall from the roots of our vines, accord perfectly with those brought over with me. In the different forms the insects assume, in their work, and in all other minutia, the two agree.

WHY I CONSIDER THE GALL-LOUSE AND ROOT-LOUSE IDENTICAL.—First, wherever this insect has been noticed in England, both the gall-inhabiting and root-inhabiting types have been found. In France, the galls occur abundantly on such of our American

*It is really amusing to witness how the facts here set forth have been received by those who never spent ten minutes' investigation of the subject in their lives. In the silk-worm disease that has of late years been so prevalent in Europe, M. Pasteur, after the most painstaking and elaborate experiments, at which he sacrificed his health, unravelled its mysteries, gave to the world the true pathology of *pebrine*, and what is more, showed how it might be eradicated. Yet, as I shall show further on, the men most interested were very slow to believe the hard, dry facts which had been snatched from the unknown, and, never having studied the case themselves, were more inclined to consider the disease as something mysterious—something altogether beyond man's understanding, and consequently uncontrollable. The most ignorant are always the most skeptical! I might mention several parties who have expressed their opinion that the *Phylloxera* has no connection with disease or decline in the Vine. To such, I simply say: examine for yourselves, before giving an opinion. Others whom I might mention go to the other extreme and assert that it must be the cause of mildew, oidium, etc., and without any good reason put a similar opinion in my mouth. To these last, I say: read aright, do not misconstrue, and by no means jump to conclusions!

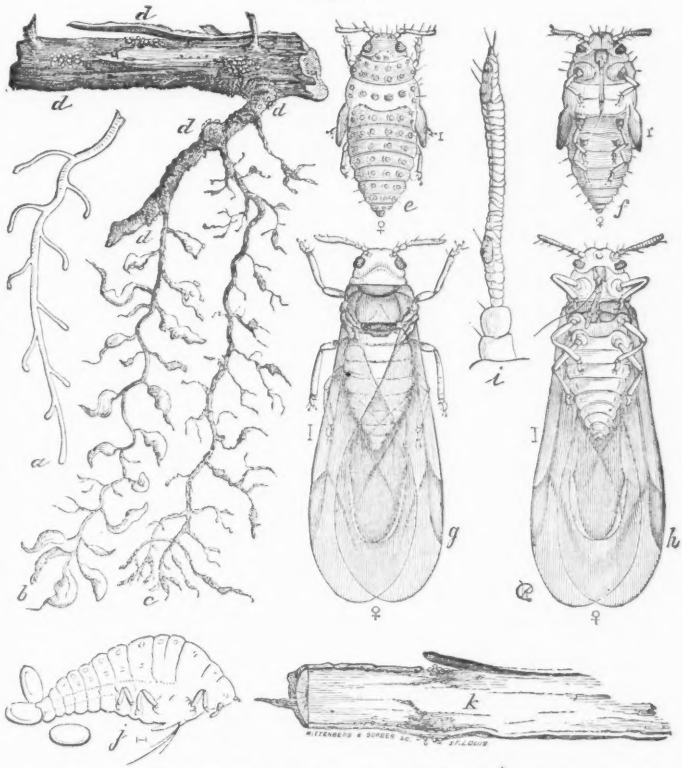
varieties as are subject to them here; while a few have occasionally been found on their own varieties. Secondly, I have successfully transferred the leaf-lice on to the roots, while M. V. Signoret has succeeded in obtaining leaf-galls from lice hatched on the roots. Thirdly, the winged form obtained by Dr. Shimer from the galls in this country agrees in its characters with those from the roots. Fourthly, the nodosities on the roots are, as already stated, perfectly analogous to the galls on the leaves, and differ only in just such a manner as one would expect from the difference in the plant tissues — a view greatly strengthened by the fact that when the gall-lice are forced, by their excessive numbers, to settle on the tendrils or leaf-stalks, they produce swellings and knots approaching more nearly to those on the roots than to the galls. These facts sufficiently attest the identity of the two types, and we have here another case of an insect possessing two distinct habits. It is also like many others of its family, polymorphic, *i. e.*, it exists in different forms; yet we have to do with but one species.

Further Facts Respecting the Habits of the Root-inhabiting Type. — The young hatched from the eggs on the roots are absolutely undistinguishable from those hatched in the galls; and the gravid apterous female differs in no respect whatever from the mother gall-louse. There is, however, a different egg-depositing form, which, as it moults, becomes tubercled, and more elongated or pear-shaped, as shown at Figure 129, *j*. Some of these tubercled individuals remain without wings, while others seem to be destined from the first to acquire wings. The young, after attaching themselves, become in a measure stationary, and remind one very much of young bark-lice. The fine hair-like setæ, which in their functions and elasticity are analogous to our tongue, become loosened from the more fleshy rostrum or sheath, as shown at Figure 129, *j*, and are often so firmly inserted into the root that the louse, if disturbed from its place, generally hangs by them. Three of the threads of this tongue are sufficiently conspicuous, but there should be from analogy, four. The females on the roots seem to be less prolific than those in the galls, and their eggs if anything are rather larger. These eggs are always of a bright yellow color, and, on the dark root, are detected with the naked eye as readily as the lice, which become darker or of a dull orange as they grow older.

The insect is found on the roots in all stages during the summer

months. In the winter it is found dormant, principally in the larva state, and no eggs are to be seen. With the circulation of the sap in spring, the activity of these young recommences, and

Fig. 129.



a, shows a healthy root; *b*, one on which the lice are working, representing the knots and swellings caused by their punctures; *c*, a root that has been deserted by them, and where the rootlets have commenced to decay; *d*, *d*, *d*, shows how the lice are found on the larger roots; *e*, female pupa, dorsal view; *f*, same, ventral view; *g*, winged female, dorsal view; *h*, same, ventral view; *i*, magnified antenna of winged insect; *j*, side view of the wingless female, laying eggs on roots; *k*, shows how the punctures of the lice cause the larger roots to rot.

in a short time afterwards eggs are deposited again. At this season the punctures of their little beaks produce very decided swellings and an excess of moisture at the wounded parts. The winged forms are by no means uncommon and commence to issue

from the ground perhaps as early as July. When I last examined the roots before my departure, or about the middle of May, no pupæ were found; but winged insects were obtained as early as July in France, and after my return I had no difficulty in obtaining all I wished, especially during the latter part of September. The pupæ are easily recognizable with a good lens, by the little dark pad-like wing-sheaths at the sides of the body (Fig. 129, *e*, *f*)—and the sexes may even be distinguished at this stage by the greater constriction of the body near these pads in the female, compared to the male, her abdomen being larger. Before giving forth the winged insect, these pupæ become quite restless and active, and in a state of nature they no doubt issue from the ground.

The winged female (Fig. 129, *g*, *h*) seems to be much more common than the male, and is distinguished by her more lengthened abdomen — the wings, when closed, extending not much more than its length beyond the tip, while in the male they extend more nearly three times its length. The dusky thoracic band is not so distinct and the abdomen is more produced at the apex in the male; and there is also a slight difference in the venation of the wings of the two sexes, which venation is best seen in the fresh specimens, as it becomes in a measure obsolete in drying. In the abdomen of the female two or three large eggs are plainly visible, especially after being soaked in acetic acid. The two-jointed tarsus or foot is also plainly visible in such specimens, and I have found the joint movable, while M. V. Signoret, of Paris, has obtained the skin of the tibia or shank with the basal joint of the tarsus hanging to it. Prof. Westwood also refers to a short basal tarsal joint in the gall insect which he described. These facts, trivial as they may appear, are very important in a scientific view, as they forever settle the differences that have existed as to the proper systematic position which the louse occupies.

Susceptibility of Different Vines to the Attacks of the Louse.—I have carefully examined a great many different kinds of vines within a circuit of thirty miles of St. Louis, as well as in Cole, Jefferson and Boone counties, in this State, and the summary which follows indicates the susceptibility of the different varieties to this disease. There may be objection on the part of some persons to the placing of some of the varieties in the following tables and the opinions both of botanists and vine-growers

are so at variance that I shall give in the subsidiary note* my reasons for so placing them. I am familiar with the views of many of the leading grape-growers of the country, and have had an opportunity of studying the genus by the excellent herbarium

*CLASSIFICATION OF THE N. A. GRAPE-VINES.— In few genera of plants is it more necessary to accumulate abundant material in order to arrive at correct classification than in the genus *Vitis*. The species are with difficulty defined, as they vary in a marked manner in different sections of the country; and the foliage of the same individual vine often varies greatly at different ages and seasons. Preserved leaves are not alone to be trusted therefore, but every stage of growth must be considered, from the wood to the different leaves, the blossom, bunch, berry and even the seed, which in its shape, and especially in the development of its raphe (or cord) furnishes, according to Dr. Engelmann, some of the most permanent distinguishing traits between the species.

It is interesting to know that not a single real species has been added to those belonging to the old territory of the United States, east of the Mississippi river, since the time of Linnæus and Michaux; though Rafinesque, LeConte, and perhaps others, have attempted to distinguish a great many more.

The number of Grape-vines bearing edible fruit,* now considered species by the best botanists in the territory of the United States, is limited to 9. They may be tabulated as follows:

I. VINES WHICH ARE OF PRACTICAL CONSEQUENCE, AS HAVING YIELDED OUR DIFFERENT CULTIVATED VARIETIES.

1. *Vitis Labrusca* Linn. Northern Fox.
2. " *Æstivalis* Michx. Summer Grape.
3. " *Riparia* Michx. River Bank Grape.
4. " *Vulpina* Linn. Southern Fox, or Muscadine.

II. VINES OF LESS CONSEQUENCE, AND WHICH HAVE THUS FAR GIVEN NO CULTIVATED VARIETIES.

5. " *Vitis Cordifolia* Michx. Winter or Frost Grape.
6. " *Californica* Benth. Confined to California.
7. " *Arizonica* Engelm. Similar to the last.
8. " *Candicans* Engelm. Mustang Grape of Texas.
9. " *Rupestris* Scheele. Bush Grape or Sand Grape.

Of these 9 species only 4 grow wild in our own state, viz; *æstivalis*, *cordifolia*, *riparia*, and *rupestris*.

In stating last year (3rd. Rep. p. 90) that our cultivated varieties had been referred to four species, including *cordifolia* and omitting *riparia*, I followed the later editions, of Gray's Manual, in which the latter is considered as a variety of the former. The reasons for adopting a different course will be found in the following synopsis which has been kindly prepared for me by the author.

THE TRUE GRAPE-VINES OF THE OLD UNITED STATES.

BY DR. GEORGE ENGELMANN OF ST. LOUIS.

1. GRAPE-VINES WITH LOOSE BARK (AT LAST SEPARATING IN SHREDS), CLIMBING BY THE AID OF BRANCHED TENDRILS, OR (IN NO. 4) SCARCELY CLIMBING AT ALL.

a. Berries small, 3—6 or rarely 7 lines in diameter; seeds obtuse, with the raphe (or cord) more or less prominent (except in No. 4) over the top. All the species of this group,

*There are a few species forming the sections (or, according to others, genera) *Cissus* and *Ampelopsis* which are now classed with *Vitis*; but they bear no edible fruit, and are otherwise easily distinguished from the true grape-vines.

of Dr. Engelmann. It is gratifying to know, therefore, that the position given to such cultivated varieties as obtain in this herbarium, agrees with that given to them by leading grape-growers — the views of the botanist and the practical man coinciding.

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just like the European grape-vine, exhibit on well grown shoots a regular alternation of two leaves each having a tendril (or its equivalent, an inflorescence), opposite to them, and a third leaf without such a tendril.

1. VITIS CORDIFOLIA *Michaux* — Usually tall, climbing high, trunks not rarely 6—9 inches in diameter. Leaves middle sized, heart-shaped, mostly entire or rarely slightly trilobed, with shallow broad teeth, usually smooth and shining on both sides, the young ones sometimes slightly downy below; berries among the smallest; in large bunches, black without a bloom, maturing late in the fall, usually with only one short and broad seed marked by a prominent raphe.

This is a common plant especially of the river-bottoms, and well known under the name of Winter grape, Frost grape or Chicken grape. It is found from New England to Texas, and westward to the western limits of the wooded part of the Mississippi valley. In this valley, at least, the fruit has a strongly- and even fetidly-aromatic taste. No cultivated varieties of the species are known.

2. VITIS RIPARIA *Michaux*— Mostly a smaller plant than the last, but with larger and more or less cut-lobed glabrous shining (or rarely when young, slightly downy) leaves, the lobes long and pointed; the teeth also more pointed than in *cordifolia*; berries as small, or usually larger than in the last, mostly with a bloom, in smaller bunches, mostly 1 or 2 seeded; seeds with a less prominent raphe.

This species prefers thickets or rocky soil on river banks and extends as far west and south as the last, and much farther north, being the only grape-vine in Lower Canada, where it is found even 60 miles north of Quebec. The northern form, in Canada, northern New York to Michigan and Nebraska, has fewer and larger berries in a bunch and is easily distinguished from *V. cordifolia*. The southwestern form, however, approaches more closely to this last species, with which Prof. Gray in the later editions of his Manual has united it. The fruit ripens earlier than that of *cordifolia*, and is much pleasanter. In St. Louis a variety found on the rocky river banks is brought to market in July. A number of cultivated varieties are referable to this species, among which the *Taylor Bullit*, the *Delaware* and the *Clinton*, are the most prominent.

3. VITIS ÆSTIVALIS *Michaux* — Smaller than the first, climbing over bushes and smaller trees, leaves large, of firmer texture than the preceding ones, entire, or often more or less deeply and obtusely 3-5 lobed, with short and shallow, broad teeth; when young always very woolly, mostly bright red or rusty; at last smoothish but dull and never shining like the preceding ones; berries usually larger than in both others and, when well grown, in compact bunches, coated with a distinct bloom; seeds usually 2 or 3 with a very prominent raphe.

This is the well known *Summer grape* common throughout the middle and southern States, usually found on uplands and in dry open woods or thickets, maturing its fruit in September. It is the most variable of our grape-vines and hence has seduced superficial observers into the establishment of numerous nominal species. A form with large leaves which retain their rusty down at full maturity has often been mistaken for *Labrusca*, which does not grow in our State. Another form, more bushy than climbing, with deeply lobed rusty-downy leaves and very sweet fruit, is *Vitis Lincecumii* of the sandy soil of Louisiana and Texas. This species assumes a peculiar form approaching *V. cordifolia* through its smaller black berries without bloom and in larger bunches, when it gets into shady woods with rich soil. Another form, with ashy-white, downy, scarcely lobed leaves, and fruit like the last mentioned, which grows in our bottoms, often climbing high trees, or growing over bushes on the banks of lakes, I have distinguished by the name of *cinerea*. It is not always easy to distinguish such forms from the other species and perhaps less so to unite them under the

When we find it so difficult to properly separate the wild species, we can no longer wonder at the difference of opinion as to the nature of many of our cultivated varieties; for some of them have become so modified that they furnish scarcely any indication of their parentage. If those grape-growers who take interest in such matters will send specimens of such cultivated varieties as they wish to properly classify, to Dr. Engelmann, either directly or through me, they will at least get the opinion of one who is

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single species *æstivalis*, unless the essential characters above enumerated be closely attended to, and the numberless gradual transitions from one form into the other be watched.

We cultivate many varieties of this valuable species, the most important of which are the *Virginia seedling*, the *Cynthiana* and the *Herbemont*.

4. VITIS RUPESTRIS *Scheele*—A small bushy plant, often without any tendrils, rarely somewhat climbing; leaves small (2—3 inches wide) mostly broader than long, heart-shaped, scarcely ever slightly lobed, with broad coarse teeth and usually an abruptly elongated point, glabrous, and of a rather light green color; berries middle-sized, on very small bunches; seeds mostly 3—4, obtuse, with a very delicate raphe.

This very peculiar grape-vine is found only west of the Mississippi, from the Missouri river to Texas and westward probably to New Mexico. In our State where it is called *Sand grape*, and in Arkansas, it grows on the gravelly banks and over-flowed bars of mountain streams; in Texas also, on rocky plains, whence the Latin name; it is there also known under the name of *Sugar grape*. Its luscious fruit ripens with us in August.

It is nowhere yet in cultivation but may in future prove of value.

b. Berries large, 7–9 or even 10 lines in diameter; raphe scarcely visible on the more or less deeply notched top of the seed.—These plants on well grown shoots bear a tendril opposite each leaf with only rare and irregular intermissions.

5. VITIS LABRUSCA *Linnæus*—Plants usually not large, climbing over bushes or small trees, though occasionally reaching the tops of the highest trees, with large (4–6 inches wide) and thick, entire or sometimes deeply lobed, very slightly dentate leaves, coated when young with a thick rusty, or sometimes whitish, wool or down, which in the wild plant remains on the lower side but almost disappears in the mature leaf of some cultivated varieties: berries large, in rather small or middle-sized bunches, bearing 2 or 3 or sometimes 4 seeds.

This plant, usually known as the *Fox-grape* or *Northern Fox-grape* is a native of the eastern slope of the continent from New England to South Carolina, where it prefers wet thickets; it extends into the Alleghany mountains and here and there even down their western declivity, but is a stranger to the Mississippi Valley. The most important varieties of this grape-vine now cultivated in our country (such as the *Catawba*, *Concord*, *Isabella*, *Hartford Prolific*, and dozens of others) are the offspring of this species; they are all easily recognized by the characters above given, and more readily by the peculiar arrangement of the tendrils as above described.

II. GRAPE-VINES WITH A FIRMLY ADHERING BARK, WHICH DOES NOT SCALE OFF; TENDRILS ALMOST ALWAYS SIMPLE; BERRIES VERY LARGE (7—10 LINES IN DIAMETER), VERY FEW IN A BUNCH; SEEDS WITH TRANSVERSE WRINKLES OR SHALLOW GROOVES ON BOTH SIDES.

6. VITIS VULPINA *Linnæus*—Bushy or sometimes climbing high, with small (2 or at most 3 inches wide) rounded, heart-shaped, firm and glossy dark green leaves, smooth or rarely slightly hairy on the under side, with coarse, large or shallow teeth.

good authority, and such action may be mutually profitable. Specimens should be sent at flowering time, and should include the whole shoot with full sized and young leaves, blossom, and tendril; and after the fruit is ripe a bunch of the berries and seeds from the same stock should follow.

The proper classification of our different varieties is of more importance in this connection than would at first appear. Since the publication of some of the facts set forth in this article, a few enterprising French grape-growers, in the districts desolated by the louse, have conceived the idea of importing from this country such varieties as are most exempt from the attacks of the *Phylloxera*, and M. LeFranc, the Minister of Agriculture, has likewise expressed his intention of so doing. Already a number of varieties, and especially the Cunningham, Herbemont, Norton's Virginia, Concord, Hartford Prolific, Clinton and Martha have been shipped to M. J. Leenhardt, of Montpellier, France, and others to Switzerland, by Messrs. Isidor Bush and Co. If America has given this plague to England, why should she not in return furnish her with vines which are capable of resisting it? At least nothing but good can come of the trial, for though our grapes are generally sneered at on the other side of the water, we have made such rapid improvements in viticulture during the last ten years that they scarcely know anything of our better kinds; and many of those which do well in Missouri will doubtless succeed in France. Such of our vines as have already been cultivated there are often differently classified by their writers to what they are by American authors, and confusion consequently ensues. Thus, one of my correspondents, M. Laliman, of Bordeaux, who has cultivated a number of them for several years, classes the Clinton and

This southern species known under the name of *Southern Fox Grape Bullace* or *Bullit-grape* is found along water-courses, not farther north than North Carolina and Arkansas, and may possibly straggle into southeastern Missouri. Some of its cultivated varieties, especially the white *Scuppernong*, are highly esteemed in the South but do not perfect fruit in the latitude of St. Louis.

I recognize only three other species of the true grape-vines in the territories of the United States. The most remarkable of these is the Mustang grape of Texas, *Vitis candicans* Engelm. (*V. Mustangensis* Buckley), with rather large, rounded, almost toothless, rarely deeply-lobed leaves; white woolly on the under side, bearing berries, which in its native country are now beginning to be made into wine; *Vitis Californica* Bentham, the only wild grape of California, has rounded downy leaves, and small berries, and is not made use of as far as is known; *Vitis Arizonica* Engelm., similar to the last, but glabrous, with middle-sized berries, reported to be of a luscious taste. Neither of these shows a prominent raphe on the seed, so that this character is peculiar only to the first 3 species here enumerated.

Taylor as *æstivalis*, and the Norton's Virginia and Delaware as *Labrusca*.*

I will now indicate the susceptibility of different varieties to the disease.

Vitis vinefera (European).— All European varieties with roots badly affected. In many instances decomposed and gone, with the vines about dead. No leaf-galls.

V. riparia (River Bank). Clinton — Leaf-galls extremely abundant. Root-lice only moderately so. Taylor—Where leaf-galls are few, root-lice abundant; where galls are abundant fewer root-lice. Delaware — A few leaf-galls; lice abundant on roots. Othello (hybrid with *vinefera*) — Both leaf-galls and root-lice, the latter tolerably numerous. Louisiana (some say a seedling of *vinefera*, others again believe it *æstivalis*) — Leaf-galls and root-lice, but neither bad. Alvey — Few leaf-galls; plenty of root-lice. Cornucopia (hybrid with *vinifera*)— No leaf-galls; roots badly affected with lice. Wild vine — Numerous leaf-galls and a few root-lice; much in same condition as Clinton.

V. æstivalis (Summer). Cunningham — No leaf-galls, but a few root-lice. Cynthiana—Occasionally a few galls; lice abundant on roots. The vine has a vigorous growth and the roots are large and strong. Herbemont — A few leaf-galls, and scarcely any root-lice. Norton's Virginia — No leaf-galls, but some root-lice.

V. Labrusca (Northern Fox). Isabella, or seedlings of Isabella—No leaf-galls; a few root-lice: roots strong and vines flourishing. Martha—No leaf-galls; very few root-lice. Hartford—No leaf-galls; very few root-lice. Ives—No leaf-galls; lice tolerably abundant on roots. North Carolina—No leaf-galls; very few root-lice. Maxatawney—No leaf-galls; root-lice quite abundant. Creveling—A few leaf-galls; root-lice abundant. Catawba —No leaf-galls; root-lice very numerous, abounding even on the larger roots as on the European vines. Gœthe (hybrid with *vinifera*)—No leaf-galls but lice on roots very numerous. In the vineyards of Messrs. Isidor Bush & Sons, of Bushburg, Mo., this vine was very vigorous and thrifty in 1869 and 1870, but has done poorly the present year. Dracut Amber—No leaf-galls; few root-lice. Wilder (hybrid with *vinifera*—No leaf-galls; not many root-lice. Challenge (hybrid with *vinifera*)—No leaf-galls,

* Etude sur les divers Phylloxera, et leur médications.

roots affected but moderately. Diana—No leaf-galls, but plenty of root-lice.

V. vulpina (Southern Fox or Muscadine)—As it is not grown in this locality, being considered absolutely worthless here, I know little about it.

From this experience it would appear that no vines of those named, are entirely free from the attacks of the root-louse; but that the European varieties are most susceptible to it; the Northern Fox, next in order, the River Bank grape next, and the Summer grape being the least affected. It would likewise appear that galls are occasionally found on all of the species except the European, and as they have, in a few instances, been found on this species in Europe, it cannot be considered entirely exempt.* Nevertheless, in general terms, the River Bank grape must be considered the species which the gall-louse prefers. Experience on this point will, no doubt, vary in different parts of the country, and more extended experience may modify some of these deductions.

We thus see that no vine, whether native or foreign, is exempt from the attacks of the root-louse. Yet, on the principle that a small dose of poison may prove harmless or even beneficial where an over-dose will kill, we find that a small number of root-lice produce no serious effects upon a vine; and that it is only where they are very numerous, and cause not only the fibrous roots but even the larger ones to waste away, that their evil effects are perceptible. With most of our native vines when the conditions are normal, the disease seems to remain in the former mild state, and it is only with the foreign kinds, and with a few of the natives under certain conditions, that it takes on the more acute form.

In France, according to M. Laliman, the American varieties which have resisted the root-louse best are the Clinton, Taylor, Herbemont (known there as Warren), and some others which are considered valueless here, such as the Pauline, Elsimboro, Lenoir Mustang of Texas, and a kind of York-Madeira; while those which succumb are the Isabella, Scuppernong, Concord, Norton's Virginia, Maxatawney, Hartford Prolific, Cynthia, etc. This experience differs a little from ours, but shows that the Labruscas suffer most there also. — *To be continued.*

*Since this was written I have been informed by Mr. Glover of the Department of Agriculture, that the leaves of certain European vines, in green-house, such as *Muscat Hamburg* and *Madam Pince*, were crowded with the galls, even as late as December; and they had begun to spread on to the *Sonora* and the *Duc de Malacoff*.

REVIEWS AND BOOK NOTICES.

CATALOGUE OF THE PENGUINS IN THE MUSEUM OF THE BOSTON SOCIETY OF NATURAL HISTORY.* — We have in this brochure of 17 pages, the first of a series of papers on the magnificent collection of birds contained in the Museum of the Boston Society of Natural History — the second in size, in respect to number of species, in America. The collection is particularly important as containing the types of most of the species described by La Fresnaye, whose large collection of birds, gathered at a great expense, was purchased by the late Dr. Henry Bryant, and by him generously presented to the Society. It is the aim of the Society to eventually publish a complete catalogue of the birds in its Museum, in a series of papers, treating of the different groups in a more or less revisionary or monographic manner; and with this auspicious beginning it is to be hoped the work will be pushed rapidly forward. Prof. Hyatt briefly discusses the general affinities of the genera and species, and arrives at the conclusion that the larger part "come to a focus in *Spheniscus minor*, which appears to hold a strictly intermediate position, but presents a nearer approach to the lower members of the genera Pygocelis, Eudyptes and Aptenodytes than to any other existing form." He finds three modifications of the family "which presumably take place upon the basis of the organization of Spheniscus," diverging in radiating lines from *S. minor*, which is regarded as closely related to the "ancestral form." After some general remarks on the structure of the feathers and other features of the external anatomy, a somewhat detailed analysis of the genera is given, and also of the literature of the *Spheniscidæ*. The genera recognized are Aptenodytes, Spheniscus, Pygocelis and Eudyptes. The Society has specimens of nine species — apparently all but one or two of the known tenable species of the group. The synonymy is given only so far as to establish the names of the species, and give reference to one or two of the best published figures. Generally, remarks are added respecting the distinctive features of each, their peculiar changes and variations of plumage.

*Catalogue of the Ornithological Collection in the Museum of the Boston Society of Natural History. *I. Spheniscidæ*, by Alpheus Hyatt. With Notes on the Osteology of the Family, by Elliott Coues, M.D., U.S.A. Proc. Boston Soc. Nat. Hist., Vol. xiv, pp. 17. May, 1872. (Read May 17, 1871.)

Dr. Elliott Coues adds some highly important observations on the osteology of the family, and compares their more prominent skeletal modifications with those of the other groups of the Pygopodes. Any one of a large number of individual bones, he asserts, is of itself characteristic of the family. "A remarkable breadth and flatness of different bones," he observes, "is the dominant characteristic; it marks several bones that are cylindrical in all other birds and hollow in most;" and adds that "foremost among the diagnostic skeletal characters of the family comes the partly confluent condition of the metatarsals, which in all other existing birds are completely fused." The compound metatarsus "shows its composition in the two lengthened fenestræ that indicate the three original metatarsals;" and Dr. Coues suggests that "this may afford a useful hint in any search for the ancestral stock or primitive type of the *Spheniscidæ*;" yet one of these fenestræ is apparently common to many of the lower water birds; while the primitive distinctness of these bones is indicated by the medullary canals that are readily seen in a transverse section of the distal extremity of the metatarsals.

This carefully prepared paper, by Prof. Hyatt and Dr. Coues, is a welcome and valuable addition to our knowledge of this most interesting and by no means well-known group of birds.

Notes on the Natural History of Fort Macon, N. C., and Vicinity.* — Under the above caption, we have a series of papers on the fauna and flora of the vicinity of Fort Macon, North Carolina, by Dr. Elliott Coues, based on two years' observation at that locality. The groups thus far fully reported upon are the Mammals, Birds and Reptiles among Vertebrates, the Crustacea, Radiata, and Mollusca, and also the Brachiopoda of the Annulata. The lists refer almost exclusively to the small island on which Fort Macon is situated, and to the waters immediately surrounding it, thus rendering the paper, by its restriction to a small area, of great value as the record of a local fauna.

The mammals observed number eighteen species, and incorporated with the list are various remarks relating to habits and external features, including about four pages respecting the opossum (*Didelphys Virginiana*). A wide range of individual variation in color, size and proportions of parts is pointed out, in connection

* Notes on the Natural History of Fort Macon, N. C., and Vicinity. By Elliott Coues. Proc. Acad. Nat. Sci. Phila., 1871, pp. 12-49, 120-148, May and July, 1871.

with which is discussed the affinities and alleged points of difference between the *D. Virginiana* of the East and the *D. "Californica"* of the West. The conclusion arrived at is that the two forms are specifically identical, — an opinion we had ourselves but a short time previously expressed.* Respecting their variations Dr. Coues thus remarks: "The more specimens I examined, the more I was struck with the variations that depend upon sex and age, as well as those that different individuals corresponding in these conditions present. An examination of these points, in the natural history of a single animal, may give results of general application; and yet in calling attention to the variability of the opossum, I do not wish to be understood as supposing that the animal is not as constant as many or most others, for I believe it to be no exception to a general standard or average in this respect. I doubt that one could study any mammal, as closely as I have the opossum, without being similarly impressed" (p.15). To the writer of the present notice, who has made individual variation in both mammals and birds a subject of special study for several years, this is cheering testimony, being corroborative of much that he had formerly to support almost alone.†

The list of birds embraces the names of one hundred and forty-two species, with quite extended notes on their habits, and memoranda of their times of arrival, breeding, departure, etc., rendering it highly satisfactory as a faunal list. There is also an extended notice (p.34, foot note) of the pterylæ of *Rallus crepitans*.

A list of the reptiles concludes the first part, and numbers eleven species. No species of batrachian was noticed on the island, though several were observed on some of the neighboring islands, as well as on the adjoining main land.

Part II begins with an apparently nearly exhaustive list of the decapodous crustacea, part of which were obtained by dredging. Twenty-eight species are enumerated, and one cirriped and one entomostracan, accompanied by full notes respecting their relative abundance, habits and conditions of occurrence. Most of the species were determined by Prof. S. I. Smith, and the remainder by the late Dr. Wm. Stimpson, whose loss to science naturalists have so recently had cause to deplore. The Brachiopoda, next in

* Bull. Mus. Comp. Zool., Vol. ii, p. 185, Apr., 1871.

† See Bull. Mus. Comp. Zool., Vol. i, No. 3 (Oct. 1869), and Vol. ii, Nos. 1 and 3 (Oct. 1870, and Apr., 1871).

order, consist of the single species, *Lingula pyramidata* Stimp., which was found in great numbers at a particular locality on the southern side of Bird Shoals.

The list of the Mollusca seems particularly full, upwards of one hundred and fifty species being enumerated, all but seven of which are marine. The marine species were referred for determination to Mr. Sanderson Smith, who has added various remarks respecting the peculiarities, etc., of the specimens examined. A portion of the species were obtained with the dredge, these being collected jointly by Drs. Coues and Packard and Prof. Morse, who together thus quite thoroughly explored every part of the harbor. Dr. Coues has added important notes respecting their several stations, abundance, etc., which add greatly to the value of the paper. While a few species obtained at this locality by Drs. Stimpson and Gill, in 1860, were not observed, some thirteen were added to Dr. Stimpson's list.

The partial list of the radiates collected embraces ten species, and the occurrence of nearly as many more, not fully identified, is indicated. Preceding the list of the mollusca is a quite detailed description of the locality explored, including the currents and shoals, with other interesting general remarks. An allusion to the changeableness of the locality recalls to us some interesting facts respecting the influence of sometimes single storms upon the fauna of some of our coast inlets. Some years since, a heavy westerly February gale depressed the water in a little bay off Orleans, Cape Cod, to such a degree that large portions of the flats usually covered at low water were laid bare, and remained so for a number of hours. The temperature at the time being in the vicinity of zero, F., a crust of ice formed over these exposed flats, which were at this time literally filled with living *Mya arenaria*, and the larger species of "razor-fish." A few years later, on visiting the locality, hardly a living specimen of either of these species could be found, but just beneath the surface the dead shells occurred in immense abundance, standing on end in their natural positions, the animals having been killed, undoubtedly, by the chilling consequent upon the exposure of the flats during the storm.

A similar destruction of molluscan life, but from another cause, came to our notice last summer (1871) near Great Salt Lake, Utah, where the water of Sulphur Springs Lake, near Salt Lake City, became so reduced in volume by evaporation as to kill all the

shells, through the excess of saline matter held in solution by the water. These shells embraced several species, which were abundantly represented. Such facts as these seem to explain the occurrence of beds of fossils under circumstances which show that they died from some sudden, though not very evident, cause.

Dr. Coues's paper forms a highly valuable contribution to the natural history of Beaufort harbor, and one that students of geographical zoology will heartily welcome. — J. A. A.

GIEBEL'S THESAURUS.* — Close upon the notable "Hand-list," of which we were lately called upon to speak, comes another general work of greater aims and claims. We have as yet only the first twenty-five signatures, constituting the first "halbband;" and we may sincerely say we wish it were necessary to wait for the whole, before judging the work, in the hope of some decided improvement becoming manifest. But as what we have in hand finishes the "Repertorium" and fairly opens the "Nomenclator," the character of the work is fully exposed. We had been led to expect great things of the *Thesaurus*, and opened it with perfect confidence; at the close of our examination — the longer protracted because our convictions became the more painfully prominent, and we were anxious to find ourselves in the wrong — we could not but regret that the fruits of such immense labor should be marred for lack of the *care* necessary for the compilation of works of reference. Dr. Giebel is sure of a storm of hostile criticism, that his work singularly invites if it does not actually enforce; for the simple reason that it is thoroughly unreliable. We have never seen a work of any considerable claims and merit, that more richly deserved the epithet "slovenly." It fairly bristles with misstatements; probably this whole number of the NATURALIST would not more than suffice to point out and correct them. The more's the pity, too, that this monument of laborious research should be defaced, not by lack of ability, not by erroneous opinions, not particularly by ignorance, but simply by carelessness. Yet, honey-combed with inaccuracy as it is, the work will, we are glad to say, become indispensable; it will find its place at the elbow of every working ornithologist; it represents too much hard work for any other result to be possible.

**Thesaurus Ornithologiæ.* Repertorium der gesammten ornithologischen literatur, und Nomenclator sämmtlicher gattungen und arten der vögel, nebst synonymen und geographischer verbreitung. Von *Dr. C. G. Giebel*, Professor an der Universität in Halle. In zwei Bänden oder vier Halbbänden. Leipzig: F. A. Brockhaus. 1872.

Of the "Nomenclator" we shall have nothing to say until it is finished, beyond the remark that this is of the nature of a dictionary, in which the genera are arranged alphabetically, those that Dr. Giebel considers synonymous being referred to what he considers to be a tenable name, the others being typographically distinguished; under the former being ranged alphabetically the species originally described by such name, under the latter those that the author regards as valid, each with its synonymy and geographical distribution. The "Repertorium" undertakes to be an index of ornithological literature from the earliest times to date. Probably those who are not specialists hardly realize what a mass of literature exists in every department of knowledge. Ornithology is one of the more circumscribed studies, hardly impinging on general affairs outside its agricultural and venatorial points of contact; yet its literature is, it seems, too voluminous to have ever been thoroughly digested. In the present work, we estimate that some seven thousand works and papers, relating wholly or in part to birds, are collated by title. Of just what this implies in the way of work, probably no one but the author himself has a very acute perception. That the list is a perfect index is not to be expected, and probably is not claimed; we could supply a number of titles ourselves, and of course better informed ornithologists could add many more; but it is certainly the nearest approach to a complete catalogue extant. The great trouble is, that the author has laboriously, ingeniously and successfully hidden away the individual titles by a remarkable system of enumerating them. They are arranged alphabetically according to authors' names, but under thirty-three separate headings. We cannot stop to enumerate these, but if our reader will try to think up as many different departments of ornithology, he will probably fail, and then a glance at the work will show how hopelessly the author has confused the subject and how completely he has defeated his aim. It is the exception, and not the rule, that any given paper falls distinctively under one of Dr. Giebel's headings; and the result is, that so far as we are personally concerned, we have no idea where to look for what we want, and doubtless our case is that of others. The location of a paper has been a matter of the author's tact in picking out its salient features, if it has any; and though he usually shows, we are glad to see, a happy knack in this regard, yet the very reverse is too often the case; and besides this, the numerous sheer

blunders are simply wonderful. For fair examples, picked up at random: —"Notice of a collection of Bird skins from Hayti," and "Ornithology of the Bermudas" are placed under Australia and Oceanica! "Ueber die Aptenodytes und Diomedeaarten *Süd-Georgiens*" under America septentrionalis! "List of birds, etc., of the District of Columbia" under America centralis! Finally, to endorse the words of a late reviewer, "misprints abound to such an extent, that the work reads not unlike first proofs just issued from the hands of a careless printer."

The defects of the work are glaring, and of the peculiarly exasperating nature that detains the most lenient critic against his will; but we must not allow them to blind us to the value of Dr. Giebel's labors, which they may overshadow but cannot eclipse. — E. C.

BOTANY.

Acclimatization of Plants. — In the "Archives des Sciences Physiques et Naturelles" of Geneva for June, Alph. De Candolle details a series of investigations of the question whether the habits of plants are changed by the action of the climate acting through a succession of generations. For this purpose he obtained seeds of plants which are widely dispersed over Europe from different localities, Edinburgh, Moscow, Montpellier and Palermo, and sowed them simultaneously and under similar conditions at Geneva. The general results of a somewhat limited series of experiments were that the seeds, obtained from the more northern localities, germinated on the whole somewhat earlier than those derived from more southern latitudes, and were also rather more rapid in arriving at maturity. The difference was still more observable in the second generation; but sufficient variation was shown in the seeds obtained from the same locality to make the results of but small value without a much larger series of observations.—A. W. B.

Effect of the Eruption of Vesuvius on Vegetation. — An interesting paper appears in the "Accademia delle Scienze Fisiche e Matematiche" of Naples, by G. A. Pasquale, on the effects of the recent eruption of Vesuvius on the plants in the neighborhood. The newest vegetation has suffered from contact with the ashes, though the effect has been neither a scorching nor drying up. The action has not been a mechanical one; for a mere closing of the

pores of the epidermis could not have caused death in so short a time. The closing of the pores and stomata is undoubtedly a secondary cause of death, but only after the lapse of some days. No change was observed similar to that produced by the vapor of boiling water. The scorching action of a high, dry temperature occurs only in the immediate vicinity of the volcano. Neither an acid nor alkaline reaction is shown by any change of color in the flowers or leaves, except a few instances of a change to blue of rose, orange, or violet colored organs, which might be attributed rather to an alkaline than an acid reaction; but these are few and doubtful. Many phenomena concur in pointing to chloride of sodium as the chief agent in the destruction of vegetable tissue. The salt was present in sufficient quantity in the falling ashes to be readily discernible to the sight, and is also met with as an efflorescence in the ashy soil. — A. W. B.

ZOOLOGY.

Calculi from the Stomach of a Horse.— A singular and interesting collection of so-called "stones" was recently taken from the intestines of a horse in North Ferrisburg, Vermont. I did not see the animal, but am told that the largest calculus had broken through the large intestine, while the rest were lying loose in its cavity. There was in all, as nearly as I can ascertain, about a pint of the calculi, of which the largest and twelve other entire specimens are before me, and fragments of three or four others. Only the largest is regular in form. This is almost perfectly spherical, being nine and a quarter inches in circumference and 2.9453 inches in diameter, and its weight is eleven Troy ounces or 364.45 grammes. The rest are very much smaller and quite irregular in form, little less so than any chance handful of pebbles, and as they are smaller they are less regular. The larger two, excepting the large one just mentioned, though irregular, approach a spherical form with two opposite sides considerably flattened, the circumferences being respectively $2\frac{3}{4}$ inches and $2\frac{5}{8}$ inches in one direction and three inches and $2\frac{7}{8}$ inches in the other, and the diameters .93 and .96 inch for the longer and .63 and .68 inch for the shorter. The rest are all more or less inferior to these in size and approach a pyramidal form, the smallest being most definitely of this form with each side of a different size, the dis-

tance from the apex of each side to the middle of the opposite face being .25 inch, .375 inch and .46 inch. The calculi are, in appearance, not unlike the common clay stones of the Connecticut River Valley though darker in color. They are composed of a series of concentric layers, which are quite a dark brown at the centre, but of lighter shades towards the outside, so that the color and appearance of the fractured surface is quite like the well known "Gibraltar Rock." The layers do not seem to differ in any other respect than depth of color. They are of somewhat variable thickness but for the most part they are from .01 inch to .03 inch and are much more distinct near the exterior than at the centre, where it is with difficulty that they are seen. The surface of all is smooth and polished and of a greenish brown color. The fracture is uneven and glassy. A chemical analysis of several by Mr Collier showed their composition to be somewhat peculiar, as they were found to be a triple phosphate of ammonia and magnesia with a little water and traces of lime and uric acid. All that were broken contained some foreign substance as a nucleus. In two instances this nucleus was a carpet tack, in the others a bit of stone. The specific gravity is 1.724 and the hardness somewhat less than calcite and rather more than selenite. The horse from which these objects were taken was sixteen years old and was sick only twenty-four hours before it died and, until the calculi were discovered, was supposed to have Bots. I am unable to find any mention of calculi as occurring in either stomach or intestines but I am told that similar ones to those described have been found in the stomach of the sheep in more than one instance, and Prof. Collier has handed me a fragment of one, which he says came from the stomach of a cow which when freshly broken has precisely the same appearance as those just described from the horse and is of nearly the same specific gravity, being 1.7049. If the mass, of which this piece is a fragment, was a perfect sphere, it must have been eighteen or nineteen inches in circumference.

The following table gives the dimensions and weight of ten of of the calculi :—

	Longest Diameter inches	Shortest Diameter inches	Weight in grains		Longest Diameter inches	Shortest Diameter inches	Weight in grains
No. 1.	2.94	2.94	5.625	No. 6.	.62	.43	40
" 2.	.96	.68	160	" 7.	.60	.44	30
" 3.	.93	.66	140	" 8.	.51	.32	23
" 4.	.68	.57	55	" 9.	.46	.38	20
" 5.	.63	.40	43	" 10.	.46	.25	15

Balls of hair very compact and smooth are of common occurrence in the stomachs of cattle, but stony concretions seem very rare. — G. H. PERKINS, *Burlington, Vermont.*

ANIMALS OF THE MAMMOTH CAVE. — [Since the account of the Blind fishes of the Mammoth Cave was published in the NATURALIST for January, 1872, I have accidentally met with the letter by Prof. B. Silliman, Jr., printed in the Amer. Jour. of Science, vol. ii, 2d series 1851, p. 332, giving an account of his visit to the cave in 1850. As there are several points of interest referred to in relation to the animals of the cave which I should have quoted in my article had I known of Prof. Silliman's at the time, I now make the following extract, especially calling attention to the statement relating to the fish *with color and external eyes*, in the hope that further information may be obtained about this otherwise unknown species. Is it the "black fish" of Tellkampf?

The account of the rat found in the cave and incapable of sight when first brought to the light, but afterwards attaining it, is of special interest in connection with the cause of blindness in the animals of the cave, and may be used as an argument that simple disuse of the organ of sight does not necessarily bring about atrophy of the eye, and that we must look to other than external conditions *for the cause* of the non-development of the eyes in many of the animals of the cave. — F. W. P.

"The phenomena of life within the cave are comparatively few but interesting. There are several insects, the largest of which is a sort of cricket with enormously long antennæ. Of this insect numerous specimens will be found among the specimens sent to Prof. Agassiz. There are several species of Coleoptera, mostly burrowing in the nitre earth. There are some small water-insects also which I suppose are Crustacean. Unfortunately, three vials containing numerous specimens of these insects were lost with my valise from the stage coach, and I fear will not be recovered. Of the fish, there are two species, one of which has been described by Dr. Wyman in the 'American Journal of Science,' and which is entirely eyeless; some ten or twelve specimens of the species were obtained. The second species of fish is not colorless like the first, and it has external eyes, which however are found to be quite blind. The craw-fish or small crustacea inhabiting the rivers with the fish are also eyeless and uncolored, but the larger-eyed and colored craw-fish, which are abundant without the cave, are also common at some seasons in the subterranean rivers, and so also it is said the fish of Green river are to be found in times of flood in the rivers of the cave. Among the collections are some

of the larger-eyed craw-fish which were caught by us in the cave. The only mammal, except the bats, observed in the cave, is a rat which is very abundant, judging from the tracks which they make, but so shy and secluded in their habits that they are seldom seen. We caught two of them, and fortunately male and female. The chief points of difference from the common rat in external characters, are in the color, which is bluish, the feet and belly and throat white, the coat which is of soft *fur* and the tail also thinly furred, while the common or Norway rat is gray or brown, and covered with rough hair. The cave rat is possessed of dark black eyes, of the size of a rabbit's eye and entirely without iris; the feelers also are uncommonly long. We have satisfied ourselves that he is entirely blind when first caught, although his eyes are so large and lustrous. By keeping them, however, in captivity and diffuse light, they gradually appeared to attain some power of vision. They feed on apples and bread, but will not at present touch animal food. There is no evidence that the cave rats ever visit the upper air, and there was no one who could tell me whether they were or were not found there by the persons who first entered this place in 1802. Bats are numerous in the avenues within a mile or two of the mouth of the cave, and Mr. Mantell thinks he has secured at least two species. Several specimens are preserved in alcohol. It was not yet quite late enough in the season when we were at the cave, Oct. 16th—22d, for all the bats to be in winter quarters, as the season was very open and warm. Still, in the galleries where they most abound, we found countless groups of them on the ceilings chippering and scolding for a foothold among each other. On one little patch of not over four by five inches, we counted forty bats, and were satisfied that one hundred and twenty, at least, were able to stand on a surface a foot square; for miles they are found in patches of various sizes, and a cursory glance satisfied us that it is quite safe to estimate them by millions. In these gloomy and silent regions where there is neither change of temperature nor difference of light to warn them of the revolving seasons, how do they know when to seek again the outer air when the winter is over and their long sleep is ended? Surely He who made them has not left them without a law for the government of their lives."

The Opossum.—This species of marsupial, seems to be widely distributed in every portion of the United States. Its original name in the Choctaw language is "shookhutta"; which signifies that he is the father or rather the originator of all hogs. It is not very swift of foot, neither is it very wild. I have frequently, when hunting in the woods, passed within a few steps of them and they did not seem to regard me. Our turkey buzzards have somehow found it out, and will alight near where they find the

Balls of hair very compact and smooth are of common occurrence in the stomachs of cattle, but stony concretions seem very rare. — G. H. Perkins, *Burlington, Vermont.*

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opossum feeding in the woods and running up on him, flap their wings violently over him a few times, when the opossum goes into a spasm, and the buzzards very deliberately proceed to pick out its exposed eyes and generally take a pretty good bite from its neck and shoulders; the opossum lying on its side all the time and grunting. I have twice seen a buzzard do as described, and once I found a poor creature trying to find something to eat with one eye out and one shoulder entirely gone, evidently caused by a buzzard.

They dwell in hollow logs, stumps and in holes at the root of the trees. They do not burrow or prepare dens for themselves, but find such as are ready made. I have seen them carrying into their holes, at the approach of cold weather, considerable bundles of dry leaves rolled up in their tail; they understand the signs of the coming spells of bad weather, and they prepare for it by making for themselves a good warm bed. They do not hibernate, but are found out hunting food in frosty weather. They possess but little caution. Hence they are often found in the poultry houses, chicken coops, smoke houses, and even in our dining rooms, rattling about in search of something to eat. I have often seen their tracks in the roads and paths where they had travelled three or four miles to a farmyard, to which they had no doubt been directed by the crowing of the roosters. They will catch a grown hen and drag her off squalling at the top of her voice and will not abandon her until the dogs which have been aroused by the uproar have overtaken and commenced cracking their bones. They will eat bacon, dry beef, carrion, any kind of fowl, rabbits, any sort of small game, almost all the insects, and fruits of every variety. They voraciously devour the muskmelon, and several species of mushrooms; in short they are nearly omnivorous.

The only case in which it manifests any respectable degree of cautiousness is when it is hunted at night in the forest; on hearing the din and noise of the hunters, it with some difficulty makes shift to climb a small tree or sapling, where, wrapping the naked, rasplike tail around some convenient limb, it quietly awaits the approaching dogs and hunters. By many people the flesh is considered delicious. In Galveston, Texas, in the proper season, a good fat opossum will sell for $1.50. Its flavor resembles that of the flesh of a young hog, but is sweeter, less gross and is no doubt a more healthy food for man. A dog will starve sooner

than eat the flesh of an opossum; negroes and many other persons are exceedingly fond of it.

During their rutting season, the males are very rampant and belligerent. Numbers will collect around a female and fight like dogs. Twenty or thirty years ago, I witnessed a case myself in the forests of Mississippi. The female was present, there were three males, two of them were fighting, while the third was sitting off a little piece, looking as though he felt as if he had seen enough. They were fighting hard and had been, from the signs in the wallowed down grass, for three or four days. Kicking over the female, who immediately went into a spasm, I made a slight examination of the pouch.

They are exceedingly tenacious of life. I have many times seen the dogs catch them and chew and crack, seemingly, all the bones in the skin, leaving them to all appearances entirely lifeless; and, going out the next morning for the purpose of removing the dead thing, would find that it had left its death bed and putting the dogs on its track trail him a mile or more before overtaking him. He would, to be sure, be found in a bad fix, but at the same time he lacked two or three more bone crackings of being dead. They cannot, like the raccoon, be so far domesticated as to form any attachment for persons or their houses, though I have two or three times found them under the floor of dwelling houses, where they had been for some time and evidently taken up winter quarters, but they did not remain there long, nor do I think they dwell long at any one place. They swim very well when it is necessary. — GIDEON LINCECUM, *Long Point, Texas. — Communicated by the Smithsonian Institution.*

HABITS OF TROPIC BIRDS. — "For our own part, not believing in our queen Moé as implicitly as we ought to have done, we began shooting the tropic birds as they flew over us, but we soon gave it up, for two reasons: — first, that we found that if we got a rocketer, the chances were ten to one that we cut the scarlet feathers out of his tail; and, secondly, because we discovered that, by diligent peering under the bushes, we might pick up as many live uninjured specimens as we liked. I never saw birds tamer or stupider, which tameness or stupidity may be accounted for by the extreme smallness of their brain, which is really not larger than that of a sparrow. They sat and croaked, and pecked, and bit, but never

attempted to fly away. All you had to do was to take them up, pull the long red feather out of their sterns, and set them adrift again. Queen Moé was right. On Tubai you may pick up tropic birds as easily as a child picks up storm-worn shells on the seashore. It was really no small comfort to be able to get specimens of this beautiful bird without betraying their confidence by shooting them from the schooner. Small-brained as they are, they are gifted with an extraordinary amount of inquisitiveness, particularly in the early morning. As we bowl along before the flashing trade-wind, we hear a few harsh screams, and up come a pair of 'bosens' with their bright scarlet tail feathers glowing in the morning sun. They make two or three sweeps around us, evidently comparing notes, and then away into the deep blue, on their own private affairs. They fish generally like the tern, to whom I suspect they are cousins-german; but they have a way sometimes of hovering perpendicularly, with the bill pressed against the breast, that I have never observed but in one other bird, the black-and-white kingfisher of the Nile. When the 'bosen' has sighted his prey in this position, he turns over in the deftest manner, and goes down straight as a gannet, up to his neck, no further, and remounts for a fresh hover. I have never had the good fortune to see the white-tailed phaeton fishing, often as I have looked for him; indeed I have rarely met him out at sea at all. The finest I have seen were hanging about the high cliffs of the Society Islands; and I do not exaggerate when I state that I have seen more than one with a glorious waving white tail feather, two good feet long though the bird itself was not much larger than a black-headed gull. What they do with their tails when they feed passed my comprehension.

Not only did we find full-grown tropic birds, but we found their eggs and young,—the former about the size of a hen's egg, prettily splashed with reddish-brown, laid on the bare sand, under a bush; the latter really handsome creatures, about the size of a herring-gull, beautifully marked with black and white (like a falcon). The bill at this stage of their existence is black, not red. When you find your young friend under a bush, he is ensconced in a small basin of coral-dust, without any nest at all, and his surroundings show him to be a cleanly thing. When you come upon him suddenly, he squalls and croaks and wabbles about, and is as disconcerted as a warm city man when you try to drive a

new idea into him unconnected with money. But he sticks stoutly to his dusty cradle, and never attempts to escape, saying plainly enough, 'My mother told me to stop here till she brought me my supper; and here I am going to stay.'" — EARL OF PEMBROKE in *South-Sea Bubbles*, p. 143. — *Ann. and Mag. Nat. Hist.*

GEOGRAPHICAL VARIATION. — At the meeting of the Boston Society of Natural History on June 19, Mr. J. A. Allen made some further remarks on "Geographical Variation in North American Birds," a subject to which he had called the attention of the Society at a previous meeting, at which he exhibited specimens illustrating the general facts of geographical variation. He briefly referred to the smaller size, generally darker colors, larger beaks, longer claws and longer tails characterizing, as a general rule, individuals of the same species living at the southern borders of their respective habitats as compared with those living further northward, and the paler tints of those inhabiting the arid portions of the interior of the continent, as compared with those of the moister adjoining districts. He alluded to the changes of nomenclature that must naturally result from the now known intergradation of forms formerly regarded as specifically differentiated, such intergradation showing them to be geographical races and not species; and called attention to the coincidence of the occurrence of the brighter colored birds, not only as respects the avian class as a whole, but in respect to families and genera, within the tropical and subtropical regions, and also the occurrence within the same regions of all forms in which the bill or tail was remarkably developed; and finally passed to a consideration of the bearing of the general facts of geographical variation upon the question of the genesis of species. While admitting the laws of so-called natural and sexual selection to be potent influences in the differentiation of animals, he thought that they were secondary rather than primary agencies, and that the conditions of environment, and especially those of a geographical or climatic character, exercised a greater influence than evolutionists were generally willing to admit, and also that the "laws of acceleration and retardation," as shown by Professors Hyatt and Cope, were necessary to explain a certain class of phenomena presented by "modification by descent."

Although some of the modifications of color were undoubtedly

"protective," — the paler tints developed in dry regions better harmonizing with the pale gray tints of the vegetation at such localities, — yet the transition was as gradual over the intervening districts as were the climatic changes themselves over the same areas; while it was claimed that evidence of the direct influence of dry heated winds upon color was abundant; and that the gradual transition between diverse forms was so uniform and general that it pointed to constant and general laws of geographical variation. When the known transitional stages between formerly supposed specific forms were exceptional, it was more or less common to regard them as the result of hybridization, but the gradual, almost imperceptible, stages of transition between well-marked forms differently situated in respect to latitude rendered such a theory now highly untenable, and scarcely more probable as applied to intergrading forms occupying localities widely separated in respect to longitude. In regard to species as distinguished from varieties, it was deemed proper to regard as *species* such groups of individuals as did not at present intergrade, and as *varieties* such groups of individuals, though more or less diverse in their extreme phases, as were found to thoroughly intergrade, — which, he remarked, is only what many and probably the majority of naturalists are practically doing.

Note on the Thread Worm (*Filaria anhingæ*) found in the Brain of the Snake Bird. — An account of this remarkable parasite was given in the "Proceedings of the Boston Society of Natural History" Oct. 7th, 1868, showing that it was present in seventeen out of nineteen birds examined, and always found in the same place, viz., the space between the cerebral lobes and the cerebellum. It was also shown that these worms are viviparous, their oviducts containing eggs in all stages of development from the egg just formed to the mature embryo. In the lower portions of the oviduct the young were hatched and ready for exclusion.

During the last winter, when in Florida, I had an opportunity, through the kindness of my friend G. A. Peabody, Esq., of examining ten additional birds. The proportion of the infected ones was less than in the previous examinations, no worms being found in four. Two of these were not mature birds, but of the age of the other two I have no record. Of the six in which worms were found, four had both male and female Filariæ, while two had only

females, viz., one had one and the other three. In the instances where both sexes were present, the eggs were found, as before, in various stages of development, while in the others, where females only existed, the oviducts were full of eggs and in the same numbers as in the others, but there were no signs of impregnation and consequently no developmental changes.

From these facts it seems almost certain that impregnation takes place in the head, and, unless both sexes are present there, the brood fails. It is also probable, on the supposition that these worms are migratory, that it is in the head of the Anhinga the sexual organs are developed, the young arriving there in an immature state.

Every attempt to find traces of this worm in other parts of the body, or even of the brain failed. —J. WYMAN.

VIVIPAROUS MINNOWS.—Specimens of a species of Pœcilia, found in some brackish lakes in the interior of the Island of New Providence, Bahamas, have been kept in an aquarium for the last three years. When first obtained they were about an inch long. The female grows in confinement to about double that length, and the male to something less, but is not one-half the bulk of his mate; both are semi-transparent and the backbone is clearly visible. The anal fin of the male consists principally of a long spine. In its normal position this spine lies close under the body and reaches backward nearly to the commencement of the caudal fin, and is evidently the intromittent organ. It is furnished with a hinge joint and is capable of being thrown forward at an acute angle, being also susceptible of a slight lateral movement. The act of copulation takes place by the male rising perpendicularly under and a little to one side of the female and making a dart at her with the spine, which is brought laterally forward at the instant of connection. The act is almost momentary and is hardly noticeable without the closest attention. Two of the females gave signs of being with young, and one morning a small fish about one-third of an inch long was discovered, but it was evident the rest had been devoured by the males, for on a subsequent occasion when a female again became gravid the males were all removed and on the next day the gravid fish had nine young, all born alive; these were placed together with the above mentioned *one* in a finger basin; they were perfect fish, and had no appearance of the yolk being attached, as is

the case with other fish. The day after their birth they ate raw beef shred very small. These ten fish are now nearly six months old and are all females; the two old ones have each had young since; one had three alive and four dead, the other four alive and four dead; neither of these latter broods lived over a month and were unable up to the time of their death to rise from the bottom of the aquarium. Between the birth of each litter there was a period of about ten weeks. Those which are alive are all females and the succeeding litters were to all appearances males. It will be a curious circumstance, and a subject for future investigation, should every alternate litter prove to be of an opposite sex to the preceding one. No fish have yet been bred from those born in the aquarium and therefore it is not known at what age they begin to reproduce. C. FITZ GERALD. — *Lieut. H. M., 1st W. India Regt., Nassau, Bahamas, March 11th, 1864. — Communicated by the Smithsonian Institution.*

MICROSCOPY.

PHOTO-MECHANICAL PRINTING. — Incidentally to a pathological report to the Surgeon General, Dr. J. J. Woodward calls attention to the familiar disadvantages of the usual means of representing in publications the magnified appearance of microscopic objects by etchings, lithographs and woodcuts. All such hand work is laborious and wasteful of time if done by the investigator, and liable to omit the most important points if intrusted to another artist. Even the microscopist himself, being unable to represent all that he sees, is obliged to select what he conceives to be of importance, and thus represents his own theories rather than severe facts. [If, however, his theories are correct, and his delineation skilful, this very power of selection and construction enables him to give a distinctness and completeness which is lacked by the photographic camera.] The advantage of truthfulness is on the side of photo-micrography, but silver prints are expensive, inconvenient, and not permanent, and the reproduction of the negatives in permanent inks is greatly desired. Two such methods are now successfully used in the United States.

By the Woodbury method a relief surface of gelatine is produced from the negative by the action of light, and from this a metal "intaglio" is produced by pressure. In this a series of suitably colored gelatine films, which constitute the prints, are formed by

mechanical means. Thus was reproduced the photograph of *Amphipleura pellucida* in the last April number of this Journal.

In the Albertype process a printing surface (not a relief) is produced through the negative on a gelatine film by the action of light. The prints thus produced are, at present, less expensive than the Woodbury prints, and more convenient for book work, but the edition is less uniform. On enamelled paper the prints are handsomer, but will not bear much handling.

Lenses Dry or Immersion. — Dr. Thomas Birt writes to the "Monthly Microscopical Journal" an enthusiastic notice of a "new" $\frac{1}{5}$th by Ross, arranged to work wet or dry by screw collar adjustment and without change of front, a peculiarity shared only, as far as he (Dr. Birt) was informed, by Powell and Lealand's $\frac{1}{4}$th. If the Ross $\frac{1}{5}$th is like some other recent lenses by the same house, it would be difficult to say too much for its excellence as an objective: the one thing that could not be said of it is that it has any possible claim to priority in respect to the peculiarity mentioned.

This expedient, like that of double fronts, is undoubtedly an American innovation. Objectives with double fronts and with double backs were made by Tolles and by Wales years ago, and were taken to London and exhibited there in advance of any knowledge of such a contrivance there. Lenses to work either wet or dry, by cover adjustment only, have been so generally made and familiarly used in this country as to be not now looked upon as an innovation at all. The question of priority is possibly a difficult one, but both Wales and Tolles made and sold them freely, long before any claim to any such arrangement was made by any foreign maker. Wales, as early as August 1867, made two objectives of this kind, to work both wet and dry with the same front, and they were exhibited at the Fair of the American Institute in New York, and received a first premium medal and diploma bearing date of October 1867; he was advised to patent the improvement at the time, but did better than that, and certainly ought to be favorably remembered for having given it to us for nothing. Tolles also constructed these objectives about the same time, having made such an objective and delivered it to a purchaser as early as June 29th, 1868, and the objective of the above date is still in existence, and is considered one of the best that have yet been constructed on that plan by its maker.

ANGULAR APERTURE OF OBJECTIVES. — In communications which have appeared in the NATURALIST and in the "Monthly Microscopical Journal" of London, different writers have treated of the improvements made in the construction of apparatus, and especially of objectives, and have chosen their own method of expressing their ideas, and of commenting upon the expressed opinions of others; but where the end aimed at is truth, and the result sought for is an advance in the quality of appliances, minor matters and side issues in the controversies are to be overlooked.

All lovers of progress in scientific research feel much pleased with the labors of investigators who make good use of the extensive means at their control, as well as also with the results which have emanated from the patient thought and close study of such men as Mr. Wenham and others abroad. We are very apt, however, to give too little credit to the intelligent instrument maker himself. The mind which combines science with practice in its application has great advantages and should be both respected and encouraged.

How we have been forced to modify our opinions, since an angle of aperture of, say, 150° in microscopical objectives was considered absolutely unattainable! No doubt the very men who honestly and firmly believed those things impossible which are now quite familiar, were as glad as any one, when they became convinced, by facts, that they had been in error.

Equally gratified, probably, will be Mr. Wenham, when he shall see for himself that, an angle of more than 82° can be attained through balsam. Within a few days, I have had a good opportunity to see a $\frac{1}{10}$th objective of Mr. Tolles' make give an angle of 92° through balsam with tank arrangement of Mr. Wenham. I feel disposed, however, to let Mr. Tolles speak of this in his own words, the more so as my time is extremely limited. — J. C.

DR. JOSIAH CURTIS, *Dear Sir*:—At my request, you were present recently when I measured the angular aperture of an immersion 1-10 in. objective when immersed in balsam. You verified the results gained at that time. We used the tank method of Mr. Wenham (see M. M. Journal, August, 1871).

The 1-10 in. tested, I stated to you, had in air angular ap. of 170° (upwards).

In water we found the angle to be 110°+.

In balsam the angle was fairly 95°, using petroleum lamp flame, thin, for light, in a darkened room. As you will remember I remarked that with sunlight I got two degrees more.

It will, I know, be of interest to you, and I am sure to some others, to hear of results of test of angle in some other cases. I will, therefore, set down here the angle of aper-

ture found to pertain to some of my immersion objectives in balsam, in water and in air.

	Air.	*Air.*	*Water.*	*Balsam.*
Single Front.	1-18 in.	170°	120°	87°
" "	1-18 in.	170°	110°	88°
Compound Front.	1-10 in.	175°	117°	95°
" "	1-13 in.	175°	105°	
" "	1-6 (high)	172°	106°	88°
Single "	1-5 in.	175°	127°	110°

The varying differences between the water and balsam angles can, in a general way, be accounted for from the formulas of construction differing considerably, each one from any other.

Of all these objectives the most effective (especially when its low power is considered) is the 1-5 in. of 110° *in balsam*. This is true of its use for objects mounted in balsam, as Rhomboides, *small*. But notably so as to its work on dry A. pellucida. My London specimen of this, received through the U. S. A. Medical Museum, is resolved into lines that *shine*, I may say. The illumination I used was petroleum lamp flame, no condensation. With the same means *all* the objectives show A. pellucida with the same illumination, but with a difference.

With sunlight and a blue cell no doubt the higher powers would have their proper advantage.

It is proper to mention that the 1-5 in. of 110° balsam angle was constructed on the plan proposed by me in the Lon. "Month. Micr. Jour." for March 1872, where I have made use of a diagram by Mr. Wenham of a 1-8 in. of his construction, to *indicate* modifications such as would give more than 81° or 82° in balsam.

With proper appliances below the balsam-slide (as pointed out by me in the Lon. Month. Micr. Jour., for July, 1871) we can with this objective (1-5 in.) utilize 110°, instead of about 81°, the limit of the amount of angle otherwise available. *In the first place* the large angle must have access to and through the balsamed object *from below*; in the next place the objective must be capable of receiving and transmitting that dimension of pencil to the eye, which thing previous to my own demonstrations has not been shown to have been done.

With much respect, yours truly,

BOSTON, July 8, 1872. ROBERT B. TOLLES.

ORGANISMS IN CROTON WATER. — Chas. F. Gissler's pamphlet on this subject can be obtained of the Naturalists' Agency, though not so stated on the title page. While microscopists generally are now approaching this question of water supply from a utilitarian direction, seeking hints of healthfulness or pestilence in the organisms they detect, the author looks upon the Croton with inquisitive eyes, deeming the water New Yorkers drink a charming field for chasing rotifers and crustaceans, water-bears and worms, and scarcely giving a thought to their dietetic value. As far as can be gathered, he judges them healthy enough, with some comparatively unimportant exceptions. The pamphlet contains some very attractive plates, which are well calculated to accomplish the author's avowed object, giving encouragement and popularity to this branch of microscopical study.

DISTRIBUTION AND ACTION OF NERVES. — Dr. L. S. Beale and Dr. E. Klein have contributed valuable papers on this subject to

the Royal Microscopical Society and to the Memoirs in the Quart. Journ. of Microscopical Science. Interesting incidental discussions may be found in the Proceedings of the Royal Microscopical Society in recent numbers of the Monthly Microscopical Journal.

Dr. Beale, in reporting his progress on this subject, offers no methods of investigation, different from those already published, but hopes for improvement in practical details, and consequently in results. He has demonstrated the distribution of nerve fibres to capillaries in nearly all the tissues of the frog, and is convinced of their similar arrangement in the higher animals. These delicate nerve fibres are seen to branch directly from the dark-bordered nerve fibres, and are often so close to the capillary as to be seen distinctly only when the vessel shrinks after death; and they may often run along on each side of the vessel, or form a plexus upon its surface. They may originate from ganglia or from sensitive and motor nerve trunks, and have intimate relations to some of the nerves of special sense, and to nerve fibres distributed to the voluntary muscles. They never, according to the author's observations, come into structural relation with the active elements of other tissues, notwithstanding the growing belief that they do so; and their influence is not dependent upon continuity of substance. The author is quite certain that muscular contraction may depend upon changes in a nerve running near the muscular fibre but distinctly separated from it. A nerve fibre often passes for some distance by the side of a cell and then is lost to view by passing behind it, or is hidden by a pigment cell, leading to the conclusion that the nerve fibre has become continuous with the substance of the cell. Such errors can be avoided only by studying extremely delicate specimens in a viscid fluid in which their position can be changed; hence the author's preference for glycerine as a medium for these investigations. A fine nerve fibre less than $\frac{1}{100000}$ of an inch in diameter may often be traced for a long distance, its edges being well defined, and nuclei occurring at certain intervals. These fibres, demonstrated by Dr. Beale ten years ago when their existence was not admitted, are believed by him to constitute the ultimate or terminal nerve networks or plexuses. He admits that these are sometimes, and probably always, compound fibres, but does not admit the existence of another plexus of far finer fibres as claimed by some other observers, preferring to discuss the bearing of what he has been able to

demonstrate in a variety of cases, rather than to reason upon the observations of others.

Dr. Klein, on the other hand, by modifying the common method of staining by chloride of gold, brings the finest nerve fibres into view so clearly that they can be easily studied with powers as low as 250 to 300. The cornea of a rabbit or guinea pig is very slightly stained with chloride of gold; and sections cut, with a razor, are examined in glycerine. Oblique and horizontal sections are examined, and the binocular microscope exhibits easily the relation of the different plexuses to each other. Only the nerve fibres are colored, but the cells of the epithelium are distinctly seen. Dr. Klein confidently claims to demonstrate non-nucleated nerve fibres far finer than the ultimate plexus of Dr. Beale. The latter observer admits that his ultimate fibres are compound and that the nuclei are somewhat to one side of the main fibre. Dr. Klein looks upon all nucleated nerve fibres as sheathed, the nuclei belonging to the sheath, and finds no nuclei in the finer and simpler fibres. By the carmine and glycerine method no more has been demonstrated than the plexus of nucleated non-medullate nerve fibres; but with the gold method the existence of non-nucleated nerve fibres among the epithelial cells is shown with certainty. The anatomical continuity of these with the larger nerve trunks can be positively seen.

Dr. Berkart agreed with Dr. Beale in throwing some doubt on the supposed influence of the nervous system on nutrition. Atrophy of the muscles, for instance, might be due directly to causes operating directly on the muscular tissue, though generally ascribed, at present, to the influence of the nerves. The influence of the nerves on secretion was, however, well established in many cases.

Dr. Murie regarded Dr. Beale's paper a rare and valuable contribution to microscopic anatomy. In the *rete mirabile* of the porpoise, we have vessels of considerable size supplied with nerves ramifying in a manner similar to those demonstrated on the capillaries by Dr. Beale in his minute dissections. The electrical organ of the torpedo has an arrangement of nerves, visible to the naked eye, much like that described as occurring in the mole's nose. If there was, in the remarkable fish referred to, "a vast electrical battery supplied by nervous influence of gigantic power, was it not very probable that the same kind of thing obtained in the arterial capillaries, modified of course to the limited exigencies

of their contractile powers?" He inclined to agree with Dr. Beale that nerves did not enter those epithelial tissues where the epithelium is continuously thrown off, as they would then be unfavorably exposed.

Mr. Stewart had examined Dr. Klein's specimens and was convinced of the "existence of a fine plexus of nerves between the cells of the conjunctival epithelium, directly continuous with the coarser plexus of nerves situated in the middle layer of the cornea." In reference to the close analogy between nerve force and electricity, and the influence of the former on the circulation, he instanced the fact that if an electric current be passed through a capillary tube filled with water, the water will flow out: electric currents also influenced the passage of fluids through dialyzing membranes.

Dr. Lawson thought that our views of microscopical anatomy had been very much advanced by Dr. Beale's paper. In experimenting on the effect of certain substances on the capillary circulation of the frog, he had always reached the results shown by Dr. Beale — "that the effect on the blood vessels was due entirely to the action of the nerves, and not to the influence of the substance employed in the experiment."

Mr. Hogg valued Dr. Beale's treatment of the nerves of the capillaries, because microscopists had not hitherto been able to discover any contractile power in the walls of the capillaries nor to settle the question of the cause of the circulation through the capillaries. Dr. Beale believed that the nerves acted rather on the muscular fibres than on the walls of the capillaries. He should think, however, that the action was directly upon the capillary vessels. In the cornea the nerves probably exist for the purpose of preventing the entrance of blood into its structure.

Dr. Leared thought Dr. Beale's views would throw some light on the question of sleep, and the action of such drugs as bromide of potassium, which probably exert their power by controlling the cerebral circulation.

Dr. Beale explained, and stated his adherence to, his former statement of doubt, whether the nerves acted directly on the capillaries or the elementary cells of secreting glands. He was also positive that the statement that the nuclei always belong to the sheath was a mistake, as in many of his specimens nuclei could be demonstrated in hosts of fine nerves, which came off from non-

medullated fibres. He claimed priority of discovery in many cases, where it had been awarded by Dr. Klein to the German histologists. Many details of structure were given in his elaborate drawings, which are not explained at length in the text, for English readers will not read long and minute descriptions of such things.

Crystalline Forms in Glass. — The beautiful fern-like clusters of acicular crystals which are liable to form in a vitreous mass slowly cooling, have been described by the "Monthly Microscopical Journal" and by "Science Gossip" as produced artificially in blowpipe beads and in porphyrine, and as occurring naturally in pitchstone. Such a crystallization often takes place as an accident in a mass of slowly cooling glass, as when, at glass works, the melted contents of a retort become accidentally ruined and they are allowed to cool and be thrown away. The crystals produced under such circumstances are generally confused and merely form opaque masses or layers in the brilliant glass; but sometimes, as in a beautiful mass kindly furnished to the writer by Mr. Harding of the glass works at Berkshire, Mass., the crystalline clusters form distinct stars or rosettes imbedded in perfectly clear glass and looking wonderfully like what almost every microscopist has wished he could make — snow-flakes perfectly and permanently preserved. The beauty of these objects is realized only when they are examined on a black field and by the binocular, and preferably by reflected light.

The Leucocytes. — Dr. J. G. Richardson's report to the American Medical Association, "On the Structure of the White Blood Corpuscles," was essentially a reassertion of the previously published doctrine of the identity of the white corpuscles of blood, pus and saliva. He is satisfied that they all act essentially alike in saline solutions, and that the salivary corpuscles are not only like white blood corpuscles distended by endosmosis when immersed in a fluid less dense than serum, but that they may, when acted upon by a dense saline solution, contract to the size of the white blood corpuscle and exhibit like amæboid movements. He also strongly insists upon the presence of a cell-wall, a question which loses much of its definiteness as well as its importance in view of the fact that the discussions of Dr. Beale have led many if not most investigators to the belief that the cell-wall, in general, is only an accident of age and circumstance, rather than an indispensable and

primary element of structure, from which we deduce that its presence may often be a question of degree rather than a question of absolute fact.

As water distends, and finally ruptures and destroys, the white blood corpuscles, it is suggested that in surgical operations, much less harm would be done to the living tissues by washing or sponging them with, instead of water, a solution of about fifty-five grains of salt to the pint of water.

Spontaneous Generation. — Dr. J. C. Dalton's very able lectures reviewing this subject, close with the reflection that now, as always, the idea of spontaneous generation is confined to those organisms of which we know least; obscurity commencing where our definite knowledge fails. Although such production would naturally exist, if at all, among the smallest and simplest organisms, still the imperfect organization of these minute forms may be only apparent, and there is every evidence that at least their regular and normal mode of production is from germs disseminated in the atmosphere. Hence they are to be regarded as cryptogamic vegetable organizations, with a definite place in the organic world.

NOTES.

At a meeting of the California Academy of Sciences, held June 5th, Mons. Octave Pavy, the Arctic explorer, was introduced by Dr. Stout, who also presented the letter of the American Geographical Society of New York, introducing and warmly commending the gentleman. Professor Davidson hoped to hear M. Pavy's views concerning the geography of the Polar regions. He announced that a great current, not marked on any of the charts, had been discovered off the northwest coast of the continent, and that only the present week he had received from Alaska complete confirmation of the discovery.

M. Pavy then addressed the Academy upon his projected expedition. He said he had no doubt of the existence of an Arctic passage from the Pacific to the Atlantic — though one that was of course impracticable for purposes of commerce. The speaker referred to the various expeditions from time to time sent out to explore the Polar regions. He said that since that of Sir John Ross, the routes of the expeditions had all been from the east of the American Continent. He (Pavy) was about to enter by a

passage hitherto untried. He believed that the Polar centre was an open sea in summer and winter, surrounded by a belt of ice, and that the great difficulty in reaching the Pole was the penetration of this belt. He believed this could be done by discovering the channel traversed by the warm ocean current from the South. There were six entrances to the Polar Basin—those eastward, between this continent, Greenland, Spitzbergen and Nova Zembla, were impracticable, because at a certain latitude powerful currents were encountered, sweeping down from the North and bringing ice with them, against which a ship could not be navigated. Through Behring's Strait, however, a warm current flowed to the North, and a clear passage through the ice-belt to the open sea must there be discovered. Dr. Kane had come to the conclusion that the ice-belt which had barred his progress in Smith's Sound, must have been the formation of not less than eighty years. All expeditions by the eastward had been stopped by impassable ice. The members of the Russian expedition, last year, had thought that they had reached the Polar Sea, but a comparison of their reckonings had shown that they had only entered a bight in the ice-belt created by the warmth of the Gulf Stream and already entered by navigators. The Gulf Stream, M. Pavy believed, sank as it expanded, and met the cold and heavy current from the North; but that it came to the surface again on reaching the Polar Sea; and retaining its heat unimpaired, maintained an open polar sea, and a moderate temperature at the Pole. In the latitude of 80° and southward of that, land birds were rarely known to stay, in consequence of the extreme cold; but they had been seen flying northward over the belt of ice; and in higher latitudes had been seen in great numbers. M. Pavy then traced on the chart the course which he intends to take. He said that passing through Behring's Strait he would take a direction to the northeast, reaching Wrangle's Land north of the coast of Siberia. This land he believed to be a continent stretching away toward the Pole, and reaching into the milder climate which he expected to find. In 1812 the Russian Government had started an expedition to explore Wrangle's Land. Several attempts were made to cross it by sleighing over the ice, but on each occasion they were baffled by the ice becoming thinner as they went farther north, until they came to open water. The great eastern ocean current, flowing upward through Behring's Strait, and rounding the shores of this

unexplored continent, Wrangle's Land, whirled eastward into the Polar basin. Then uniting with the waters of the Gulf Stream, the southern currents were formed which swept through the straits leading into Baffin's Bay and down upon the shores of Spitzbergen and Nova Zembla. The woods common to the shores of Siberia were found strewn upon the coasts of these islands, and confirmed the theory. A portion of the great Japan current branched off, M. Pavy said, to the south of Alaska, and produced the fine climate, enjoyed along this coast. Another evidence of an open polar sea, to the north of the ice-belt, was the fact that one species of whale, commonly passed northward at the approach of winter, seeking clear water and avoiding the perils of a frozen surface. M. Pavy said he expected to reach Wrangle's Land by the 1st of September, and would occupy the time from that date until May 1873, in crossing northward by means of sledges and dogs, over the continent, which he supposes Wrangle's Land to be. On reaching the open sea, he will abandon his sledges, turn his dogs loose, and launch the India rubber raft, which he takes with him, set sail, and steer for the axle of the earth. Having achieved the triumph of reaching it, he will shape his course by that of the great polar currents, and steer southeast for Cape Alexander, passing through Smith's Sound, down Baffin's Bay, and out into the Atlantic Ocean.

Professor Davidson opposed some of M. Pavy's theories. He said that he would as soon expect to find an ice-cream mountain in Africa as a warm Polar basin. He said that his own Arctic explorations had shown a different state of facts concerning the direction of the currents, than that assumed by M. Pavy. The Gulf Stream, he believed, flowed northward between the shores of Greenland, Spitzbergen and Nova Zembla, and, rounding the Polar Sea, flowed southward again through the straits leading into Baffin's Bay. He denied, also, that there was any reason to believe Wrangle's Land to be a continent. He cited instances in which the "false horizons" of northern latitudes, had caused erroneous observations to be taken by explorers. He considered the latest European charts of the Arctic regions, approached through Behring's Strait, erroneous in important particulars. He thought that M. Pavy would meet with more difficulties than he had anticipated. He said that M. Pavy had greatly over-estimated the magnitude and effect of the current as it passed through

Behring's Strait. "Knowing the size of a dog's throat it is easy to tell what he can swallow." Behring's Strait is twenty-five miles wide, and has an average depth of twenty-five fathoms. The rate of the current is from one and a half to three knots an hour. The current, therefore, must be of little account, and entirely inadequate to produce the effect attributed to it by M. Pavy. Still Professor Davidson felt sure that the expedition would result in great benefits to the cause of science, and he was only sorry that M. Pavy had decided to return by the Atlantic instead of by the Pacific.

[To show the diversity of opinion that exists in relation to this subject, we copy the following from the Proceedings of the Royal Geographical Society of April 22d, as given in "Nature."—EDS.]

"On Recent Explorations of the North Polar Region, by Captain Sherard Osborn, R. N. Captain Osborn commenced by alluding to his advocacy of a Polar Expedition *via* Smith Sound in 1865, and stated that the Duke of Somerset, then First Lord of the Admiralty, though apparently sufficiently favorable to the general proposal of a Government Expedition, urged upon him by a deputation from the Society who waited on him in that year, declined to assume the responsibility of recommending an expedition, owing to the difference of opinion which then reigned with regard to the best route to be followed. The alternate route to Smith Sound was that by the seas of Spitzbergen, advocated by Dr. Petermann and others, on the ground that the Gulf Stream, flowing in that direction, maintained an open sea to the Pole. He (Captain Osborn) and the promoters of the Expedition were content to wait the result of efforts made soon after by the Swedes and Germans to carry out the views of the German geographer. Seven years had elapsed, and we were now in a position to say that the advocates of the Spitzbergen route had been proved entirely wrong, whilst those who believed Smith Sound to be the best route were right. Captain Koldeway, who commanded both the German Expeditions, states, as the result of all his efforts, that "one can hardly resist the conviction that the hope of attaining the North Pole by ship, or of finding an open sea around the Pole, are alike among the most improbable of things. I confess that I myself was misled by representations in Dr. Petermann's 'Geographische Mittheilungen,' and held it to be at least possible by following a line of coast, to penetrate by ship far into the central Arctic region, and then certainly to make one's way to the Pole. A winter in East Greenland, the most careful observation of these mighty masses of ice, their movements and formation, and of the whole condition of temperature, have radically cured me, and all

my companions of this idea. . . . If the principal object be the nearest possible approach to the Pole, I am quite of Osborn's opinion that the best way appears to be through Smith Sound. Here one can penetrate to the 78th parallel, and then one has a continuous line of coast running north, which has been sighted as far as the 82nd parallel. Along this coast one would have to work one's way in spring with dog-sledges. I consider it a wild undertaking to penetrate towards the Pole by ship between Spitzbergen and Nova Zembla." No one could undo the effect of evidence so honest and conclusive as this. The Duke of Somerset rested his decision to delay action on the importance of first being furnished with the results of the Swedish Expedition then on its way to Spitzbergen. The Swedes during the last seven or eight years had sent no less than four expeditions to the verge of the Polar region; and the conclusion of their scientific leader, Von Nordenskiöld, is that in summer it is not possible to penetrate by ship through the pack, and that an open Polar Sea is a mere hypothesis destitute of foundation. The Swedish authorities further state that the only way to approach the Pole is that proposed by the English Arctic officers, of exploring on sledges in the spring. Here, then, are the results for which the First Lord of the Admiralty in 1865 desired to wait. After a review of the voyage of the Austrian Lieutenants Payer and Weyprecht last summer, in which they found open sea a little to the north and west of Nova Zembla, and which discovery is to be followed up by a second expedition in the present summer, Capt. Osborn concluded by an eloquent appeal to the English people not to allow the final laurels of Polar discovery to be wrung from them by the sailors or explorers of any other nation. In the discussion which followed, Dr. J. D. Hooker spoke of the important questions in the science of botany which a North Polar Expedition alone could elucidate; such as the extension nearer the Pole of fossil plants like those of Disco in Greenland, which indicate a former temperate climate in 70° north. Dr. Carpenter advocated a Polar Expedition as a necessary complement to the one the Government were about to dispatch to the Pacific to investigate the deep-sea ocean currents, and so forth. Accurate investigations of current-temperature, etc., of the Polar Ocean were of the highest importance to the right comprehension of the true theory of oceanic movements. Admiral Sir George Back stated that he entirely approved of the Smith Sound route as the one best to be adopted for a North Polar Expedition. Sir Leopold M'Clintock also spoke to similar effect. Admiral Richards explained the interest attaching to the completion of the geography of Greenland, which ought to be achieved by the English. He was strongly of opinion that a Government expedition, and by the English, was alone competent to finish the work of Arctic discovery. Mr. R. H. Scott read a letter from Von Nordenskiöld, in which he stated that a Swedish expedition would start for

Spitzbergen this summer, winter in the islands to the north, and attempt a journey towards the Pole in May, 1873, with reindeer-sledges.

THE HASSLER EXPEDITION.— Here we are north of the equator again. We arrived at this port on the 25th, all well. We have touched at many places along the western coast of South America. At Payta, the last place on the coast before going to the Galapagos Islands, a large collection was made considering the time we remained there, and among the fishes were two specimens, male and female, of a Cestracion; these we also found at the Galapagos. All the collections we had on board at that time were sent to New York by the U. S. S. Ossipee which sailed the same day we did. We left Payta on the 6th inst, sailing directly for Galapagos arriving there on the 10th inst. We anchored the first night in Post Office Bay, a little haven on the north side of Charles Island which is one of the most southern of the group. After leaving Charles Island, we stopped at Albermarle, James, Jervis and Indefatigable Islands, collecting more or less at every stopping place. Our collection at the Galapagos is very satisfactory, being very large, and includes, in fish, fifty-two species. We found in great quantities the two large species of Amblarhynchus, so accurately described in Darwin's "Voyage," etc., and obtained some thirty of each species. Some of the land species were three or four feet long and one weighed thirteen pounds. We have twenty-five birds' skins and many birds in alcohol, three seals' skins and a number of skulls. Jervis Island seemed to be quite an extensive seal rookery and we saw hundreds of land seals on the shore. They were very tame, thus giving us a favorable opportunity to study them. There was one family group on the beach which we looked at as long a time as we pleased, being only a few feet from them. The mother appeared not to be alarmed as long as we did not touch her two young ones: they were walking about on all fours like a dog, their hind and fore feet bent forward. We found inhabitants (seven persons) only on Charles Island, of those we visited, although other islands are inhabited. We left the Islands on the 19th, making nine days' stay.— J. HENRY BLAKE, *Panama*, June 30th. [Since the receipt of this letter, Count Pourtales has returned to Cambridge, and we understand that Professor Agassiz and other members of the Expedition will soon return home by the way of San Francisco.— EDS.]

ANSWERS TO CORRESPONDENTS.

L. M., Norwich, Conn. — The singular moth found on the cucumber vine is the *Ægeria cucurbitæ* of Harris.

E. M. B., Templeton, Mass. — The plant is *Marchantia polymorpha*, one of the Hepaticæ, or liverworts.

C. W., Wethersfield, Conn. — The chrysalis in the stem of the currant is that of the common Currant Borer (*Trochilium tipuliformæ* Linn.) — an importation from Europe. It is, of course, necessary that the larvæ of *Nematus centricosus* should undergo their last moult before they can become pupæ. — C. V. R.

— —, Lonsdale, R. I. The insect sent is *Corydalus cornutus*, noticed p. 436, Vol. i, of the NATURALIST.

EXCHANGES.

Pollen of Passiflora, and various **Poduræ** offered in exchange for Microscopic specimens. — SWAN M. BURNETT, M.D., *Knoxville, Tenn.*

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